FILE

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

November 13, 2006

Ms. Chris Ann Gahagan
Enlibra LLC
5402 Pleasant Grove Lane
Midlothian, VA 23112

RE: BALLY GROUND WATER CONTAMINATION SUPERFUND SITE
FOCUSED FEASIBILITY STUDY
FINAL COMMENTS LETTER

Ms. Gahagan:

The United States Environmental Protection Agency (EPA) is in receipt of the document titled, "Focused Feasibility Study", dated September 29, 2006. The document was prepared by Arcadis G&M, Inc. (Arcadis).

EPA has the following comments regarding this document:

1. Page 5, 2nd paragraph. The paragraph indicates that the Remedial Investigation/Feasibility Study (RI/FS) for the Site was performed to evaluate 1,4-dioxane. This is incorrect, please review and revise this paragraph.

2. Page 6, 4th bullet. Please indicate what document revealed 12,000 parts per billion (ppb) of total volatile organic compounds (VOC) in Bally municipal well number three (MUN-3).

3. Page 7, last sentence. The reference to "Appendix A" appears to be incorrect. Please revise.

4. Page 10, 2nd paragraph. Arcadis states, "*Discharge to the stream will also encourage natural degradation of 1,4-dioxane. Modeling of a stream similar in character to the West Branch resulted in a surface water half life for 1,4-dioxane of 34 hours (SCWD, 2001).*" EPA has reviewed the reference cited by Arcadis and believes that this fate and transport assertion is incorrect. The referenced study appears to have applied to 1,3-dioxolane. Please review this FFS paragraph and the reference cited, and clarify the text. The same study is cited in Section 5 of the FFS.

5. Page 10, 2nd paragraph. Arcadis states, "*As stated above, including these factors (dilution, aeration) would instantly decrease the concentration of 1,4-dioxane below 3 ug/L.*" What is this statement based upon? Has modeling been performed to substantiate this statement?

6. Page 11, Section 2.1. The second sentence has a typographic error (no period).

7. Page 11, Section 2.2. Please add a table to the FFS with Applicable or Relevant and Appropriate Requirements (ARAR), and To Be Considered Criteria (TBC). The table should be kept simple; an example follows:

ARAR or TBC	Citation	Description	Classification (Applicable/Not Applicable)	Applicability to Selected Remedy

8. Page 11, Section 2.2. Page 25 of the FFS (Section 4.2.2.5) mentions that wetland disturbance will be required to implement Alternative 1 (construction of discharge pipeline). Please add the appropriate wetland-related ARAR to this section of the FFS.

9. Page 12. Please clarify that 112 ug/L is the average monthly discharge limitation for 1,4-dioxane in the PADEP National Pollutant Discharge Elimination System (NPDES) permit.

10. Page 16, Section 3.2.1. The following activities should be included and discussed in this alternative:

A. MONITORING PLAN: Long term monitoring of the Bally ground water contamination plume to confirm that operation of the new municipal well is not impacting the current extent of the plume.

B. CONTINGENCY PLAN: The establishment of a contingency plan that can be implemented if the Bally plume is confirmed to be moving towards the new municipal well at concentrations of concern.

11. Page 20, 3rd paragraph, 1st sentence. The plume monitoring program (which monitoring wells, sampling frequency, new wells, etc), and contingency plan will have to be proposed to EPA for review/comment/approval during the remedial design process.

12. Page 21, 1st paragraph. See previous comment.

13. Page 22, Section 4.2.2.1. See previous comment.

14. Page 22, Section 4.2.1.3. Please add one sub-alternative to the FFS, as follows: Alternative 1 – Installation of a New Ground Water Source (Section 4.2.1), Installation and Operation of a New Municipal Supply Well (Section 4.2.1.1 - same), Continued Air Stripping Treatment at MUN-3 (Section 4.2.1.2 – same), Advanced Oxidation Process (AOP) treatment added to MUN-3 treatment system with discharge to unnamed tributary of the West Branch (current location). Please consider the following comments as part of your response:

A. Based on a review of the FFS, the installation of a new municipal water supply well does appear to be the most appropriate remedial option to address 1,4-dioxane in the Bally water system, and associated human health concerns.

B. The continued operation of MUN-3 does appear to be necessary to control the migration of the Bally ground water contamination plume, and to protect downgradient private wells.

C. It is expected that the NPDES discharge limitations at the West Branch (potential future discharge location), and the Unnamed Tributary of the West Branch (current discharge location) are protective of human health and the environment.

D. Page 26, Section 4.2.3, 2nd paragraph. Please include the following two technologies in the FFS for the sub-alternative: Hydrogen Peroxide/Ozone Destruction (Applied Process Technology HIPOX), and Photocalysis (Purifics Photo-Cat). Please consider these technologies in context of the required flow from MUN-3, and the NPDES discharge limitations at the current discharge location.

E. Page 27. In several locations on this page of the FFS, the potential applicability of an AOP treatment system at MUN-3 is discounted because of the use of MUN-3 as the source for a public water supply. If an AOP treatment system is implemented at MUN-3 for discharge to surface water only, does that impact the FFS conclusion regarding AOP applicability?

F. Page 28, Section 4.2.3.2. Could residual (bromate, formaldehyde) generation be controlled through AOP treatment system pilot testing, design, monitoring? Would residuals be created by a Photocalysis (Purifics Photo-Cat) system?

G. Page 4.2.3.8. Are similar costs associated with the implementation of Hydrogen Peroxide/Ozone Destruction (Applied Process Technology HIPOX), and Photocalysis (Purifics Photo-Cat) treatment systems?

15. Page 26, Section 4.2.2.8. Remove the reference to EPA. EPA's preferred remedy will be presented in a Proposed Remedial Action Plan, after the completion of the FFS review/comment/approval process.

16. Table 3, Titanium Dioxide Photocatalytic Oxidation. This treatment technology was considered not suitable for implementation at public water systems. Please see comment 14E above.

17. Table 3. Please explain the number ranking system (what does 1, 2, 3, 4, 5 mean?).

18. Table 4. Please define the unit "LS".

19. Table 5. Please prepare similar cost evaluations for Hydrogen Peroxide/Ozone Destruction (Applied Process Technology HIPOX), and Photocalysis (Purifics Photo-Cat) systems.

20. Table 5. This table lists a line-item of $165,217 for Treatment System Design and Permitting. Please elaborate on this. The creation of an AOP treatment system for MUN-3 is not expected to represent a substantial design project. Variables should include flow rate, influent concentration, and allowable effluent concentration. AOP treatment system vendors should be familiar with the AOP technologies and target contaminant (1,4-dioxane) to minimize design expense. Also, what portion of the $165,217 is required for permitting (consulting, permit fees, etc)?

21. Table 5. EPA has performed a review of available literature for AOP treatment system costs. The capital cost for the AOP treatment system ($559,130; UV/peroxide in this case) seems very high. Please provide cost estimate documentation (including documentation from vendors) that supports this cost estimate.

22. Table 5. Would the additional operator labor be required if the AOP treatment system were not discharging to a public water system? What does "Additional Operator Labor (1/2 time)" mean?

EPA COMMENTS PROVIDED AFTER INTERIM COMMENTS LETTER (10/30/2006)

23. Under Alternative 1, the FFS recommends that a certified bog turtle habitat evaluator be present during construction of the pipeline in an area previously delineated as potential bog turtle habitat. EPA Region 3 BTAG guidance clearly states that the potential for endangered or threatened species to be present within a project area must be established by the U.S. Fish & Wildlife Service (USFWS) or the appropriate state agency and documented in the form of a letter. We further recommend that this occur, or be confirmed, at key phases of the project. At a minimum, it is recommended that this occur when the RI/FS work plan is prepared, prior to completion of the FS or preparation of the proposed plan (if more than two years has elapsed), during remedial design, and at each Five Year Review. The pertinent documentation should be provided to the EPA BTAG.

In this instance, as there was a clear indication of the potential presence of a protected species in the project area, and in an area potentially impacted by remedial activities, the recommended identification / consultation process should have been initiated as it may result in impacts to the project design and / or schedule. This process should be initiated immediately. It is recommended that the referenced wetland delineation report be provided to the BTAG and the appropriate resource agencies (USFWS Pennsylvania Field Office and the PA Fish and Boat Commission).

In cases where potential bog turtle habitat exists and this species may be present, the procedures that must be followed **prior to** any potential impact are clearly delineated. First, a bog turtle Phase I habitat evaluation must be completed. (The necessary information may have been provided in the 2004 Greene wetland delineation report.) If potential bog turtle habitat is identified on the site during the Phase I habitat evaluation, further coordination with USFWS

will be necessary. USFWS will either concur or not concur with the results of the Phase I habitat evaluation. USFWS may then either require a Phase II bog turtle survey or require special conditions for the proposed work. Common conditions include, but are not limited to, seasonal restrictions on work and/or buffer zones around the wetlands. These conditions would be established by USFWS, not suggested in the field by a certified bog turtle surveyor. It should be noted that there are very specific seasonal conditions for the Phase II survey. Failure to properly conduct the survey may result in project delays of up to one year.

24. Page 9, Section 1.2.5. The fate and transport discussion must be expanded to address the fate of 1,4-dioxane in all potentially impacted media. This is particularly important as the preferred alterative includes the discharge of the contaminant to surface water. The FFS should specifically address the natural degradation of the contaminant in the aquatic system and the processes controlling the degradation.

25. Page 11, Section 1.2.7. The fate and transport mechanisms for 1,4-dioxane in ground water should be described here.

26. Page 21, Section 4.2.1.1. It is stated that 1,4-dioxane was not detected above the proposed target for this compound of three parts per billion. It is not clear if 1,4-dioxane was detected at all. Please clarify.

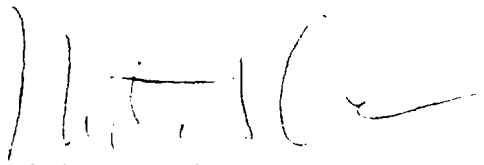
27. Page 28, Section 4.2.3.2. The discussion here indicated that bromate and formaldehyde were detected in treated water by ozonation; and formaldehyde was detected in water treated by UV/peroxide. Furthermore, it is stated that consistent byproducts testing for these compounds generally was not conducted at currently operating treatment systems. To better understand the potential impact of formation of these byproducts, a more thorough discussion of this topic is warranted. It would be helpful to have additional information to answer the following questions: were the analyses made performed at all systems using these treatment technologies; how often in each system; what was the range of concentrations of the harmful byproducts; what are the possible secondary treatments available for these compounds?

28. Page 13. The NPDES permit is an ARAR not a TBC. The NPDES discharge will not be on-Site, therefore, the permit waiver provisions of CERCLA will not apply. All permit requirements will apply.

29. Page 23, Section 4.2.2.2. Arcadis should remove "TBCs" from this paragraph. For example, the first sentence of this section should read: "This alternative complies with the regulatory requirements for drinking water and discharge to surface water. A permit from the Department's Water Supply and Management Section to operate the new public water supply well is an applicable regulatory requirement. Monitoring of 1,4-dioxane effluent concentrations will be conducted in accordance with the NPDES permit requirement."

Please respond to these comments in writing. Please contact me if you have any questions regarding this project at (215) 814-3286.

Sincerely,



Mitch Cron, RPM
Western PA/MD Remedial Branch

Cc Asuquo Effiong, PADEP
Steve Demars, PADEP
Toni Hemerka, Borough of Bally
Jennifer Hubbard, EPA
Kathy Davies, EPA
Bruce Pluta, EPA

ARCADIS
Infrastructure, environment, facilities

ARCADIS U S , Inc
6 Terry Drive
Suite 300
Newtown
Pennsylvania, 18940
Tel 267 685 1800
Fax 267 685 1801
www arcadis-us com

Mitch Cron
USEPA Region III
Hazardous Site Cleanup Division (3HS22)
1650 Arch Street
Philadelphia, PA 19103

ENVIRONMENT

Subject:
Bally Groundwater Contamination Superfund Site
Focused Feasibility Study
Response to USEPA Final Comments

Date
12 January 2007

Contact
Michael Bedard

Phone.
267.685.1800

Email
mbedard@arcadis-us.com

Our ref
NP000597.0002.00017

Dear Mr. Cron:

On behalf of Sunbeam Products, Inc. (Sunbeam), ARCADIS U.S., Inc. (ARCADIS) is writing to provide you with responses to the United States Environmental Protection Agency (USEPA) comments on the Bally Groundwater Focused Feasibility Study (FFS) as presented in your correspondence dated 13 November 2006. The USEPA comments and the Sunbeam responses to the comments are as follows:

1. **EPA Comment: Page 5, 2nd paragraph. The paragraph indicates that the Remedial Investigation/Feasibility Study (RI/FS) for the Site was performed to evaluate 1,4-dioxane. This is incorrect, please review and revise this paragraph.**

   Sunbeam Response: Comment noted. This paragraph has been revised accordingly.

2. **EPA Comment: Page 6, 4th bullet. Please indicate what document revealed 12,000 parts per billion (ppb) of total volatile organic compounds (VOC) in Bally municipal well number three (MUN-3).**

   Sunbeam Response: The concentration of "just under 12,000 ug/L" at MUN-3 was reported in the Draft Feasibility Study Report by Remcor, Inc., during May 1989. The text has been amended by citing this document.

3. **EPA Comment: Page 7, last sentence. The reference to "Appendix A" appears to be incorrect. Please revise.**

Sunbeam Response: This reference refers to the figure in Appendix A of the FFS document entitled: "Summary of Results: March 2003 Groundwater Sampling Event."

4. **EPA Comment: Page 10, 2nd paragraph. Arcadis states, "*Discharge to the stream will also encourage natural degradation of 1,4-dioxane. Modeling of a stream similar in character to the West Branch resulted in a surface water half life for 1,4-dioxane of 34 hours (SCWD, 2001).*" EPA has reviewed the reference cited by Arcadis and believes that this fate and transport assertion is incorrect. The referenced study appears to have applied to 1,3-dioxolane. Please review this FFS paragraph and the reference cited, and clarify the text. The same study is cited in Section 5 of the FFS.**

   Sunbeam Response: This paragraph has been deleted. In addition, The fifth and sixth sentences of the second paragraph of Section 5.1 have been deleted.

5. **Page 10, 2nd paragraph. Arcadis states, "*As stated above, including these factors (dilution, aeration) would instantly decrease the concentration of 1,4-dioxane below 3 ug/L.*" What is this statement based upon? Has modeling been performed to substantiate this statement?**

   Sunbeam Response: See Response #4.

6. **EPA Comment: Page 11, Section 2.1. The second sentence has a typographic error (no period).**

   Sunbeam Response: The text has been revised accordingly.

7. **EPA Comment: Page 11, Section 2.2. Please add a table to the FFS with Applicable or Relevant and Appropriate Requirements (ARAR), and To Be Considered Criteria (TBC). The table should be kept simple; an example follows:**

   Sunbeam Response: A table summarizing the applicable ARAR and TBC values, their respective origins, a description of each, and their resulting

classification based on existing site conditions has been prepared to address this comment. This table is included as Table 7.

8. **EPA Comment: Page 11, Section 2.2. Page 25 of the FFS (Section 4.2.2.5) mentions that wetland disturbance will be required to implement Alternative 1 (construction of discharge pipeline). Please add the appropriate wetland-related ARAR to this section of the FFS.**

   Sunbeam Response: A new third paragraph has been added to page 13 of the FFS to describe PADEP Wetland and Water Encroachment permits as ARARs associated with pipeline construction.

9. **EPA Comment: Page 12. Please clarify that 112 ug/L is the average monthly discharge limitation for 1,4-dioxane in the PADEP National Pollutant Discharge Elimination System (NPDES) permit.**

   Sunbeam Response: The average monthly and maximum monthly discharge limits for 1,4-dioxane are 112 and 224 ug/L, respectively, as detailed in the NPDES permit (Permit #: PA 0055123). The text has been revised to provide additional clarification.

10. **EPA Comment: Page 16, Section 3.2.1. The following activities should be included and discussed in this alternative:**

    A. **MONITORING PLAN: Long term monitoring of the Bally ground water contamination plume to confirm that operation of the new municipal well is not impacting the current extent of the plume.**

    B. **CONTINGENCY PLAN: The establishment of a contingency plan that can be implemented if the Bally plume is confirmed to be moving towards the new municipal well at concentrations of concern.**

    Sunbeam Response: Discussion of Alternative 1 has been revised to include details regarding the development of a long-term monitoring plan and a contingency plan associated with the operation of the new groundwater source. A detailed analysis of these plans will be developed further during Remedial Design activities. The text has been amended to reflect this approach.

11. **EPA Comment: Page 20, 3rd paragraph, 1st sentence. The plume monitoring program (which monitoring wells, sampling frequency, new wells, etc), and contingency plan will have to be proposed to EPA for review/comment/approval during the remedial design process.**

    Sunbeam Response: This paragraph has been revised to include the following: "To assure that the long term operation of PW-01 does not promote adverse migration of the existing chlorinated VOC plume towards well PW-01, preventive measures have been defined to first allow assessment of any plume changes, and then secondly to outline a course of action to mitigate any plume movement. These measures include the plume monitoring program and contingency plan which will be formally proposed to the USEPA for review and approval during the remedial design process. USEPA and ARCADIS conducted a work session in September 2006 to review future groundwater monitoring plans (installation of additional deep monitoring well MW-07, etc.). Additional work sessions to discuss the details of plume monitoring will be conducted as necessary."

12. **EPA Comment: Page 21, 1st paragraph. See previous comment.**

    Sunbeam Response: Comment noted.

13. **EPA Comment: Page 22, Section 4.2.2.1. See previous comment.**

    Sunbeam Response: Comment noted.

14. **EPA Comment: Page 22, Section 4.2.1.3. Please add one sub-alternative to the FFS, as follows: Alternative 1 – Installation of a New Ground Water Source (Section 4.2.1), Installation and Operation of a New Municipal Supply Well (Section 4.2.1.1 - same), Continued Air Stripping Treatment at MUN-3 (Section 4.2.1.2 – same), Advanced Oxidation Process (AOP) treatment added to MUN-3 treatment system with discharge to unnamed tributary of the West Branch (current location). Please consider the following comments as part of your response:**

    A. **Based on a review of the FFS, the installation of a new municipal water supply well does appear to be the most**

appropriate remedial option to address 1,4-dioxane in the Bally water system, and associated human health concerns.

Sunbeam Response: Comment noted.

B. The continued operation of MUN-3 does appear to be necessary to control the migration of the Bally ground water contamination plume, and to protect downgradient private wells.

Sunbeam Response: Comment noted.

C. It is expected that the NPDES discharge limitations at the West Branch (potential future discharge location), and the Unnamed Tributary of the West Branch (current discharge location) are protective of human health and the environment.

Sunbeam Response: Comment noted.

D. Page 26, Section 4.2.3, 2nd paragraph. Please include the following two technologies in the FFS for the sub-alternative: Hydrogen Peroxide/Ozone Destruction (Applied Process Technology HIPOX), and Photocalysis (Purifics Photo-Cat). Please consider these technologies in context of the required flow from MUN-3, and the NPDES discharge limitations at the current discharge location.

Sunbeam Response: Several AOP treatment methods were evaluated in Section 3.1 of the FFS, including Ozone-Catalyzed Hydrogen Peroxide Oxidation (Section 3.1 1; this is the Applied Process Technology HIPOX process) and Titanium Dioxide Photocatalytic Oxidation (Section 3.1.3; this is the Purifics Photo-Cat process) The reasons that these treatment methods were not retained for further analysis for drinking water treatment are presented in Sections 3.1.1 and 3.1.3. These FFS sections discuss these treatment methods in terms of drinking water treatment. However, the limitations discussed in Sections 3.1.1 and 3.1.3 are also relevant for treatment prior to discharge to the current surface water discharge location.

Water discharged to the present surface water discharge location would need to be treated to 3 ug/L or less. The ability of these methods to consistently treat effluent to such a low concentration is questionable. Furthermore, the potential for formation of treatment byproducts such as

bromate and aldehydes (see Section 4.2.3.2) also make treatment less viable. In addition, even if there were higher confidence in the ability of these treatment methods to consistently achieve 1,4-dioxane treatment to 3 ug/L or less, and if there were no concerns over byproduct formation, the additional logistics and operational costs associated with these treatment methods would make them not cost effective as compared to construction and use of a pipeline for discharge to the West Branch Perkiomen Creek. Therefore, a sub-alternative that incorporates these technologies has not been included in this section of the FFS.

E. Page 27. In several locations on this page of the FFS, the potential applicability of an AOP treatment system at MUN-3 is discounted because of the use of MUN-3 as the source for a public water supply. If an AOP treatment system is implemented at MUN-3 for discharge to surface water only, does that impact the FFS conclusion regarding AOP applicability?

Sunbeam Response: Yes, see response 14D above.

F. Page 28, Section 4.2.3.2. Could residual (bromate, formaldehyde) generation be controlled through AOP treatment system pilot testing, design, monitoring? Would residuals be created by a Photocalysis (Purifics Photo-Cat) system?

Sunbeam Response: Pilot testing prior to treatment system design and construction would provide some additional information on residual formation, but would not guarantee control for a permanent full-scale system. Residual formation is possible for any of the AOP treatment methods.

G. Page 4.2.3.8. Are similar costs associated with the implementation of Hydrogen Peroxide/Ozone Destruction (Applied Process Technology HIPOX), and Photocalysis (Purifics Photo-Cat) treatment systems?

Sunbeam Response: While ARCADIS did not prepare detailed cost estimates for these treatment methods, they would be expected to have similar or higher costs than those presented in Table 5 of the FFS. ARCADIS

did receive a cost proposal from Purifics that was significantly higher than the corresponding capital and annual O&M costs presented in Table 5.

15. **EPA Comment: Page 26, Section 4.2.2.8. Remove the reference to EPA. EPA's preferred remedy will be presented in a Proposed Remedial Action Plan, after the completion of the FFS review/comment/approval process.**

    Sunbeam Response: The sentence: "The USEPA has stated that replacing the Bally municipal water supply source is the preferred option given the present 1,4-dioxane TBC for drinking water of 3 ug/L" and the "However" from the following sentence have been removed from the document

16. **EPA Comment: Table 3, Titanium Dioxide Photocatalytic Oxidation. This treatment technology was considered not sultable for implementation at public water systems. Please see comment 14F above.**

    Sunbeam Response: Comment noted; see Response #14.

17. **EPA Comment: Table 3. Please explain the number ranking system (what does 1, 2, 3, 4, 5 mean?).**

    Sunbeam Response: The number ranking system included in Table 3 has been removed to clarify the presentation of available treatment technologies. The ranking columns have been removed from the table and have been replaced by a "Retained?" column that details why technologies were or were not suitable for consideration.

18. **EPA Comment: Table 4. Please define the unit "LS".**

    Sunbeam Response: The abbreviation "LS" refers to a "Lump Sum" cost The notes below Table 4 have been amended to include this description.

19. **EPA Comment: Table 5. Please prepare similar cost evaluations for Hydrogen Peroxide/Ozone Destruction (Applied Process Technology HIPOX), and Photocalysis (Purifics Photo-Cat) systems.**

Sunbeam Response: See Response #14. Complete cost evaluations for these advanced oxidation processes are not necessary as they are unsuitable for treatment consideration (Table 3).

20. **EPA Comment: Table 5. This table lists a line-item of $165,217 for Treatment System Design and Permitting. Please elaborate on this. The creation of an AOP treatment system for MUN-3 is not expected to represent a substantial design project. Variables should include flow rate, influent concentration, and allowable effluent concentration. AOP treatment system vendors should be familiar with the AOP technologies and target contaminant (1,4-dioxane) to minimize design expense. Also, what portion of the $165,217 is required for permitting (consulting, permit fees, etc)?**

Sunbeam Response: Design of an AOP treatment system would include the following: design of a new treatment building, treatment units, treatment system automation and controls; electrical service upgrade coordination; Operations & Maintenance/process safety manual; response to USEPA, PADEP and Borough comments on design; and, PADEP permit approval from both the NPDES and Water Supply programs. These items would require substantial labor effort. Approximately $30,000 of the $165,217 would be required for labor efforts associated with permitting. Permit fees were not included in the $165,217 estimate, as they would represent only a small fraction of the total cost.

21. **EPA Comment: Table 5. EPA has performed a review of available literature for AOP treatment system costs. The capital cost for the AOP treatment system ($559,130; UV/peroxide in this case) seems very high. Please provide cost estimate documentation (including documentation from vendors) that supports this cost estimate.**

Sunbeam Response: The capital costs for the UV/peroxide AOP treatment system includes costs for the following activities: mobilization and demobilization, treatment building and construction, electrical service upgrade and installation, purchase and installation of UV treatment components, reagent storage and treatment tanks, as well as additional modifications to the existing treatment system. Increased cost for this AOP is also derived from the demand for two treatment units, thereby ensuring the attainment of MCLs prior to discharge to the public water supply system.

The costing summary provided in Table 5 has been itemized to reflect the associated price of each of these activities. Relevant vendor quotes obtained for this AOP will be provided to USEPA under separate cover.

22. **EPA Comment: Table 5. Would the additional operator labor be required if the AOP treatment system were not discharging to a public water system? What does "Additional Operator Labor (1/2 time)" mean?**

    Sunbeam Response: Operation of an AOP treatment system would be far more complicated and time intensive than the existing air stripper system. The additional operator O&M cost accounts for the incremental increase in labor required for treatment system operation, beyond the costs necessary to operate the existing air stripper. This labor would be necessary for ongoing O&M activities to ensure efficient operation of the AOP treatment system, and therefore would be necessary regardless of discharge location.

23. **EPA Comment: Under Alternative 1, the FFS recommends that a certified bog turtle habitat evaluator be present during construction of the pipeline in an area previously delineated as potential bog turtle habitat. EPA Region 3 BTAG guidance clearly states that the potential for endangered or threatened species to be present within a project area must be established by the U.S. Fish & Wildlife Service (USFWS) or the appropriate state agency and documented in the form of a letter. We further recommend that this occur, or be confirmed, at key phases of the project. At a minimum, it is recommended that this occur when the RI/FS work plan is prepared, prior to completion of the FS or preparation of the proposed plan (if more than two years has elapsed), during remedial design, and at each Five Year Review. The pertinent documentation should be provided to the EPA BTAG.**

    In this instance, as there was a clear indication of the potential presence of a protected species in the project area, and in an area potentially impacted by remedial activities, the recommended identification / consultation process should have been initiated as it may result in impacts to the project design and / or schedule. This process should be initiated immediately. It is recommended that the referenced wetland delineation report be provided to the BTAG and the

appropriate resource agencies (USFWS Pennsylvania Field Office and the PA Fish and Boat Commission).

In cases where potential bog turtle habitat exists and this species may be present, the procedures that must be followed prior to any potential impact are clearly delineated. First, a bog turtle Phase I habitat evaluation must be completed. (The necessary information may have been provided in the 2004 Greene wetland delineation report.) If potential bog turtle habitat is identified on the site during the Phase I habitat evaluation, further coordination with USFWS will be necessary. USFWS will either concur or not concur with the results of the Phase I habitat evaluation. USFWS may then either require a Phase II bog turtle survey or require special conditions for the proposed work. Common conditions include, but are not limited to, seasonal restrictions on work and/or buffer zones around the wetlands. These conditions would be established by USFWS, not suggested in the field by a certified bog turtle surveyor. It should be noted that there are very specific seasonal conditions for the Phase II survey. Failure to properly conduct the survey may result in project delays of up to one year.

Sunbeam Response: Pursuant to the USEPA Region 3 BTAG guidance, the Phase I wetland delineation report was completed and submitted to PADEP in December 2004. As detailed in this document, it was recommended that a certified bog turtle evaluator be present during pipeline construction through wetland areas.

The Phase II Visual Bog Turtle survey conducted during the appropriate seasonal and climatic conditions in May 2005 indicated that bog turtles did not exist in the subject wetland areas. This was acknowledged by the United States Fish & Wildlife Service (USFWS) and the Pennsylvania Fish & Boat Commission (PAFBC) in correspondence dated 23 August 2005. Details of this report are presented in Appendix A of the Detailed Hydrogeologic Water Resources Investigation Report (ARCADIS, 2006).

24. **EPA Comment: Page 9, Section 1.2.5. The fate and transport discussion must be expanded to address the fate of 1,4-dioxane in all potentially impacted media. This is particularly important as the preferred alterative includes the discharge of the contaminant to surface water. The FFS should specifically address the natural**

degradation of the contaminant in the aquatic system and the processes controlling the degradation.

Sunbeam Response: This comment appears to be directed at Section 1.2.7 (Fate and Transport). A second paragraph has been added to this section.

25. **EPA Comment: Page 11, Section 1.2.7. The fate and transport mechanisms for 1,4-dioxane in ground water should be described here.**

Sunbeam Response: Comment noted; see Response #23.

26. **EPA Comment: Page 21, Section 4.2.1.1. It is stated that 1,4-dioxane was not detected above the proposed target for this compound of three parts per billion. It is not clear if 1,4-dioxane was detected at all. Please clarify.**

Sunbeam Response: The paragraph has been revised to read: "Analytical results indicated no constituents were detected above PADEP MCLs for Community Groundwater Sources, for constituents for which MCLs have been defined by PADEP. PADEP and USEPA have not established an MCL for 1,4-dioxane, and 1,4-dioxane was not detected above the laboratory detection limit in any sample collected from the Well Site."

27. **EPA Comment: Page 28, Section 4.2.3.2. The discussion here indicated that bromate and formaldehyde were detected in treated water by ozonation; and formaldehyde was detected in water treated by UV/peroxide. Furthermore, it is stated that consistent byproducts testing for these compounds generally was not conducted at currently operating treatment systems. To better understand the potential impact of formation of these byproducts, a more thorough discussion of this topic is warranted. It would be helpful to have additional information to answer the following questions: were the analyses made performed at all systems using these treatment technologies; how often in each system; what was the range of concentrations of the harmful byproducts; what are the possible secondary treatments available for these compounds?**

Sunbeam Response: A thorough discussion of byproduct formation is presented in ARCADIS' letter that is referenced on page 26 (Section 4.2.3).

ARCADIS does not have the detailed information necessary to answer all of the questions above related to analyses performed/frequency of analyses/range of concentrations for operating treatment systems. Questions like these were asked by ARCADIS during the information gathering period for this evaluation. Most operators/vendors never thought to (or were never required to) analyze for these byproducts, and therefore never analyzed for those constituents. As for possible secondary treatments for these compounds, the most likely method of treatment would be to increase the residence time within the reactor vessel, increase dosage of hydrogen peroxide, or include a second reactor vessel in series, rather than rely on a different treatment process to address byproducts.

28. **EPA Comment: Page 13. The NPDES permit is an ARAR not a TBC. The NPDES discharge will not be on-Site, therefore, the permit waiver provisions of CERCLA will not apply. All permit requirements will apply.**

    Sunbeam Response: Comment noted. The sentence: "Therefore, the NPDES permit establishes an applicable action-specific TBC of 112 ug/L" has been revised to replace "TBC" with "ARAR".

29. **EPA Comment: Page 23, Section 4.2.2.2. Arcadis should remove "TBCs" from this paragraph. For example, the first sentence of this section should read: "This alternative complies with the regulatory requirements for drinking water and discharge to surface water. A permit from the Department's Water Supply and Management Section to operate the new public water supply well is an applicable regulatory requirement. Monitoring of 1,4-dioxane effluent concentrations will be conducted in accordance with the NPDES permit requirement."**

    Sunbeam Response: Comment noted. The text has been amended to reflect the proposed EPA changes, and the additional references to TBCs have been removed.

We trust that these responses sufficiently address your comments. If you require further information, please do not hesitate to contact Sunbeam or ARCADIS.

Sincerely,

ARCADIS U.S., Inc.

Christopher T. Sharpe
Project Geologist

Michael F. Bedard, P.E.
Project Manager

Copies
R. Reinhart, USEPA
S. Werner, PADEP
A. Effiong, PADEP
T. Hemerka, Bally Borough
L. Borland, Jarden Corp.
C.A. Gahagan, EnLibra LLC
R. Mowrey, Jarden Corp.

ARCADIS

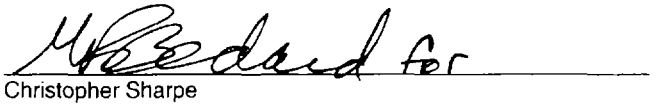
Focused Feasibility Study

Bally Groundwater Contamination Site
Municipal Water Supply

29 September 2006

Revised January 2007

ARCADIS



Christopher Sharpe
Project Scientist

Michael F. Bedard, PE
Principal Engineer/Project Manager

Focused Feasibility Study

Bally Groundwater Contamination Site, Municipal Water Supply

Prepared for
Sunbeam Products, Inc.

Prepared by
ARCADIS U.S., Inc.
6 Terry Drive
Suite 300
Newtown
Pennsylvania 18940
Tel 267 685 1800
Fax 267 685 1801

Our Ref.
NP000597.0002.00014

Date
29 September 2006
Revised January 12, 2007

Executive Summary 1

1. Introduction and Site Characterization 1

1.1 Introduction 1

1.1.1 Objectives of Report 1

1.1.2 Report Organization 2

1.2 Site Characterization 2

1.2.1 Site Geologic and Hydrogeologic Setting 2

1.2.2 Site History 3

1.2.2.1 Summary of air stripper process operations 7

1.2.3 Discovery of 1,4-dioxane in Groundwater 7

1.2.3.1 Site Activities Due to 1,4-dioxane 8

1.2.4 Risk Assessment 9

1.2.5 Ecological Risk of 1,4-dioxane 9

1.2.6 Nature and Extent of Contamination 10

1.2.7 Fate and Transport 11

2. Identification of Remedial Action Objectives and ARARs/TBCs 11

2.1 Remedial Action Objectives 11

2.2 Identification of Applicable Relevant and Appropriate Requirements and To Be Considered Criteria 11

3. Remedial Technologies, Technology Screening and Development of Remedial Alternatives 14

3.1 Identification and Screening of Remedial Technologies 14

3.1.1 Ozone-Catalyzed Hydrogen Peroxide (O_3/H_2O_2) Oxidation 15

3.1.2 Oxidation via Direct Ozonation 15

3.1.3 Titanium Dioxide (TiO_2) Photocatalytic Oxidation 16

3.1.4 UV/Hydrogen Peroxide Oxidation 16

3.2 Development of Remedial Alternatives 16

3.2.1 Alternative 1: Installation of a New Groundwater Source 17

3.2.2 Alternative 2: Additional Treatment at MUN-3 Using Advanced Oxidation Processes 17

4. Detailed Analysis of Alternatives 18

4.1 Remedial Alternative Screening Criteria 18

4.2 Bally Groundwater Treatment Alternatives Analysis 19

4.2.1 Alternative 1 – Installation of a New Groundwater Source 19

4.2.1.1 Installation and Operation of New Municipal Supply Well 19

4.2.1.2 Continued Air Stripping Treatment at MUN-3 22

4.2.1.3 Pipeline Construction and Utilization to Discharge MUN-3 Effluent to West Branch Perkiomen Creek 23

4.2.2 Criteria Assessment for Alternative 1 23

4.2.2.1 Overall Protection of Human Health and the Environment 23

4.2.2.2 Compliance with ARARs 24

4.2.2.3 Long-term Effectiveness and Permanence 24

4.2.2.4 Reduction of Toxicity, Mobility or Volume through Treatment 25

4.2.2.5 Short-term Effectiveness 25

4.2.2.6 Implementability 26

4.2.2.7 Cost 26

4.2.2.8 State and Support Agency Acceptance 26

4.2.2.9 Community Acceptance 27

4.2.3 Alternative 2 – Additional Treatment at MUN-3 Using Advanced Oxidation Processes 27

4.2.3.1 Criteria Assessment for Alternative 2 28

4.2.3.2 Overall Protection of Human Health and the Environment 29

4.2.3.3 Compliance with ARARs 29

4.2.3.4 Long-Term Effectiveness and Performance 29

4.2.3.5 Reduction of Mobility, Toxicity, or Volume 30

4.2.3.6 Short-Term Effectiveness 30

4.2.3.7 Implementability 31

4.2.3.8 Cost 31

4.2.3.9 State/Support Agency Acceptance 31

4.2.3.10 Community Acceptance 31

5. Recommended Alternative 31

5.1 Comparative Analysis of Options 32

5.2 Recommended Alternative 32

6. References 32

Tables

1 Bally Well Number 3 Analytical Results for 1,4-Dioxane.

2 Chemical-Specific Relevant and Appropriate and To-Be-Considered Requirements for 1,4-Dioxane in Drinking Water.

3 1,4-Dioxane Treatment Technology Comparison

4 Cost Estimate for Alternative 1: Groundwater Supply Well Installation and Operation

5 Cost Estimate for Alternative-2: Municipal Well No. 3 Treatment

6 Cost Estimates for Public Water Supply and Groundwater Treatment Options

7 Applicable Relevant and Appropriate and To-Be-Considered Requirements for 1,4-Dioxane

Figures

1 Site Location

2 Geological Basemap

3 Selected Groundwater Sampling Results 1982 to July 2006 and extent of 1,4-dioxane

4 Groundwater Flow and TCE Plume During Final Pumping Test – December 12, 2005.

5 Historical 1,4-dioxane Concentrations

6 Alternative 1 Components and Infrastructure

7 Alternative 2 Proposed A.O.P. Treatment Flow Schematic Diagram.

Appendices

A Existing Site ARARS for VOCs

Executive Summary

In February 2003, 1,4-dioxane was detected in groundwater provided to the Bally public water system by Municipal Well Number 3. The concentrations of 1,4-dioxane detected were approximately 30-45 micrograms per liter. As a result, in September 2003, the United States EPA and Sunbeam Products, Inc. (Sunbeam) entered into an Emergency Administrative Order on Consent pursuant to the Safe Drinking Water Act (AOC) requiring that Sunbeam monitor the 1,4-dioxane levels and prepare a Focused Feasibility Study (FFS) to consider two potential remedies: 1) treatment of the water presently produced by Municipal Well Number 3 to remove the 1,4-dioxane to a level less than 3 micrograms per liter, or another concentration approved by the United States EPA if 3 micrograms per liter is not practical and achievable on a consistent basis; and, 2) replacement of the Bally Municipal Well Number 3. This document was prepared to comply with the FFS requirements of the AOC.

ARCADIS G&M Inc., at the request of Sunbeam investigated both the treatment and well replacement options. The treatment portion of this evaluation focused on advance oxidation processes (AOPs).

The screening of technologies indicated that only two processes were viable for further evaluation. The processes retained for further evaluation were gaseous ozone (ozonation) and ultra-violet light/hydrogen peroxide (UV/peroxide) treatment. These two processes were further evaluated through bench scale testing conducted by Trojan Technologies Incorporated and the Michigan State University.

The bench scale testing indicated that further testing of these treatment technologies would be required prior to implementation because byproducts such as bromate and formaldehyde were observed in the test system effluent during the bench scale testing. Furthermore, the bench scale testing indicated that treatment is not presently a viable alternative because of the potential for byproduct formation.

Sunbeam explored various locations for possible installation of a new municipal drinking water well. Well PW-01, located north of the borough was identified as a potential new source for Bally. Aquifer testing conducted at this location indicated that this well produces a sufficient quantity of water meeting the Pennsylvania Department of Environmental Protection requirements for a community water supply source.

This Focused Feasibility Study recommends the replacement of Municipal Well Number 3 with a new municipal supply well. In this case well PW-01, installed and tested in 2005 and 2006, would be the recommended replacement well. It is therefore recommended that Alternative 2 (Replacing Municipal Well Number 3 with well PW-01) be selected as the alternative to address the 1,4-dioxane in groundwater at the Bally Groundwater Contamination Superfund Site.

1. Introduction and Site Characterization

1.1 Introduction

The Bally Groundwater Contamination Superfund Site (Site) is located in eastern Berks County, Pennsylvania at the southern end of the Borough of Bally (Bally). Figure 1 shows the location of Bally. Groundwater contamination at the Site consists of volatile organic compounds (VOCs) discovered in approximately 1981, and 1,4-dioxane, discovered in 2003 during a special sampling event. The remedial strategy for addressing VOCs in groundwater was described in the 1989 Record of Decision (ROD) and 1990 Explanation of Significant Differences (ESD) for the Site. Groundwater is presently extracted from Municipal Well Number 3 (MUN-3) within Bally treated to remove VOCs and used to supply water to the Bally municipal water system. The present MUN-3 treatment system does not remove the 1,4-dioxane that is present in the groundwater.

An Emergency Administrative Order on Consent (AOC) was executed in September 2003 by the United States Environmental Agency (USEPA) and Sunbeam Products, Inc. (Sunbeam). The AOC presented a proposed target low level drinking water (target) for 1,4-dioxane at the Site of 3 micrograms per liter (µg/L), although a higher value could be calculated in consultation with the USEPA and PADEP if 3 µg/L was not feasible to achieve. Additionally the AOC required that a Focused Feasibility Study (FFS) be conducted to determine an appropriate remedial alternative for establishing a public water supply for Bally. Pursuant to the AOC, this FFS has been conducted to evaluate a focused subset of remedial alternatives that have been previously screened and present the most viable options. The purpose of the FFS is to facilitate selection of a remedial alternative that is protective of human health and the environment.

This FFS has been conducted in accordance with the FFS Work Plan for the Site (ARCADIS, 2004), the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), the USEPA's Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (USEPA, 1989), and the National Oil and Hazardous Substances Contingency Plan (NCP).

1.1.1 Objectives of Report

The objectives of this FFS include the following:

- Summarize Site geologic/hydrogeologic environment and history;

- Identification of remedial action objectives (RAOs);
- Development of potentially applicable or relevant and appropriate requirements (ARARs) and to-be-considered (TBCs) standards and guidance;
- Discussion of potential remedial alternatives;
- Comparative evaluation of remedial alternatives; and
- Selection of recommended remedial alternative for groundwater.

1.1.2 Report Organization

This report is organized into the following sections:

1 Introduction and Site Characterization

2 Identification of Remedial Action Objectives and ARARs/TBCs

3 Remedial Technologies, Technology Screening and Development of Remedial Alternatives

4 Detailed Analysis of Alternatives

5 Recommended Alternative

6 References

1.2 Site Characterization

The following sections summarize the geologic and hydrogeologic environment in which the Site is located and the results of historic investigative and remedial work conducted at the Site.

1.2.1 Site Geologic and Hydrogeologic Setting

Bally is located at the northwestern edge of the Piedmont Physiographic Province, an area characterized by rolling hills and meandering streams. Figure 2 shows the Site Geological Base map. To the northwest of the Site lie steep hills of the Reading Prong

section of the New England Physiographic Province. The two provinces are divided by a northeast-southwest trending fault zone that creates a zone of increased groundwater permeability, storage and recharge (ARCADIS, 2006).

Bedrock in the area to the northwest of the fault zone is composed of resilient and low permeability granitic gneiss which forms the core of the Reading hills. Within the fault zone a wedge of dolostone and (reportedly) quartzite is present. The high permeability dolostone in conjunction with the physically rendered secondary porosity created by stress and movement in the fault zone create a prolific water-bearing zone. This zone recharges the thick alluvial deposits of the Brunswick Formation that compose the Piedmont Physiographic Province (Ibid).

The Brunswick Formation is composed of shale, siltstone and sandstone with interspersed zones of fanglomerate, which are high permeability alluvial deposits composed of angular dolostone, quartzite and gneissic clasts in a red shale-sandy-siltstone matrix. The fanglomerate is only present near the edge of the Newark Basin where the fault zone and the associated sharp topographic divide provide the necessary elevation and source material.

Similar to many other small towns and villages that dot the fault zone, Bally was sited based upon its proximity to springs that emerge from the hillsides of the Reading Prong. Bally has historically derived its water supply from these springs and from wells completed in the prolific aquifer created by the fault zone and adjacent fanglomerate deposits. Extensive investigations (ARCADIS, 2006; CEC, 1994; CEC, 1996; CEC, 2002; REMCOR 1989) have been conducted to characterize the aquifer.

1.2.2 Site History

Manufacturing activities at what was previously the Bally Engineered Systems (BES) plant began in the 1930s with the production of high-quality cabinets and cedar chests by the Bally Case and Cooler Company (BCC). Production facilities were briefly commissioned in the 1940s by the government to assist in the war effort. In the 1950s the main product line became continuous line, porcelain coated meat display cases and porcelain panels for use in constructing building facades. In 1984 BCC was renamed Bally Engineered Structures, Inc. (BES).

Use of degreasing solvents at the plant occurred in two principal areas. A 2,000-gallon capacity degreasing tank was formerly located in what became the BES carpentry shop. This tank was used from the late 1950s until approximately 1969 to degrease

the shells of the meat display cases prior to the application of a urethane insulating material. The cases were dipped in the tank and staged nearby to dry prior to applying the insulation. Trichlorethylene (TCE) was the only solvent known to be used in this tank.

The second area was a 600 gallon degreasing tank for cleaning small parts used to fabricate an interlocking mechanism for the insulated panels. This tank was in use from the early 1960s until the mid 1980's. 1,1,1-Trichloroethane (TCA) was used in this small parts degreasing tank. In addition, solvents were reportedly used as flushing agents to clean case molds and urethane foam injection nozzles in the plant foaming department from the mid-1960s to the mid-1980's.

The principal chlorinated VOCs found in the aquifer are TCA, TCE and 1,1-dichloroethene (DCE). Use of TCE was suspended in about 1969 along with the cessation of production of the meat display cases. TCA was used in the small parts degreasing tank from 1980 until 1986, when it was replaced by a nonchlorinated solvent. None of the principal chlorinated VOCs found in the aquifer were used as flushing agents in the foaming department after 1986. Spent degreasing solvents were managed as a Resource Conservation and Recovery Act (RCRA) hazardous waste at the Site after hazardous waste regulation began in 1980 (EPA, 1989). Flushing agents used in the foaming department were recycled and reused.

A review of archival aerial photographs suggested that four shallow lagoons existed at the facility (EPIC, Undated). Two lagoons were present from approximately 1955 until they were relocated to the south to facilitate plant expansion and the two southern locations were constructed. The second pair remained until approximately 1970 when they were backfilled to facilitate the construction of the present office building located to the south of the second lagoon location. As part of the Remedial Investigation (RI) both the lagoon sites and the areas of degreasing solvent use in the plant were examined in an effort to identify a contamination source area at the Site (USEPA, 1989).

Samples collected in 1982 from MUN-3 exhibited elevated levels of VOCs. Consequently, use of MUN-3 as a public water supply ceased, and the town reactivated Municipal Well No. 1 (MUN-1). MUN-1, in conjunction with a group of springs to the northwest of Bally, were formerly used to supply water to the municipal system during the period between 1959 and 1979, prior to installation and permitting of MUN-3. In addition to the municipal wells, two industrial wells were actively used within Bally and several residential wells operated down gradient of the Site. The

residential wells have all since been abandoned and the industrial wells are used only for industrial process uses (USEPA, 1989).

BES signed a consent order in January 1987 with EPA to conduct the remedial investigation and feasibility study (RI/FS) at the Site. The purpose of the RI/FS was to evaluate alternatives for the mitigation of the 1,4-dioxane. A Phase III RI was conducted by Remcor and the report was issued in May1989 (USEPA, 1989). The RI identified six possible compounds of concern (COC)s for the Site. These six possible COCs are tetrachloroethylene (PCE), TCE, DCE, TCA, 1,1-dichloroethane (DCA) and methylene chloride. The investigation concluded that all of these compounds with the exception of DCA were present at concentrations sufficient to warrant their inclusion in the final list of COCs.

Investigation to delineate the extent of the groundwater contaminated zone indicated that the COCs were mostly present between the former BES facility and MUN-3 with the greatest concentrations near in the vicinity of the northern edge of the facility (between the 86-3 well cluster and the 86-4 well cluster (Figure 3). Data derived from the RI and subsequent investigations indicate that when MUN-3 operates it effectively captures and controls the migration of COCs from the former BES facility (Figure 4). During the period from 1979 to 1982 before the discovery of contamination in MUN-3 the two wells operated intermittently. Then during the period from 1982 to early 1987 MUN-3 was pumped intermittently (but not used for potable water) as a means of plume control while MUN-1 was operated to supply water to Bally. This was followed by a period of more than two years during which MUN-3 was completely inactive and MUN-1 was used exclusively. As a result during this period the dissolved phase groundwater plume expanded towards MUN-1. Following the two year period of inactivity, once the NPDES permit was renewed, MUN-3 was reactivated as a means of plume control (Remcor, 1989).

The RI identified that the primary complete exposure pathway was through untreated groundwater entering the Bally municipal potable water supply and through one hand-pumped private well within Bally. Therefore, in parallel with the preparation of the RI report, a treatment system for MUN-3 was designed and installed.

Based upon the RI report and a draft Feasibility Study (FS) also issued in May 1989 (USEPA, 1989) the USEPA issued a Record of Decision (ROD) identifying groundwater extraction and treatment (pump and treat) through air stripping to remove Site related VOCs from the Bally groundwater and drinking water supply as the

selected remedial alternative for the site. The cleanup goals for VOCs at the Site were established by the ROD (Appendix A). This remedy remains in place and continues to actively reduce the extent and concentration of the COCs in the groundwater plume; removing approximately 1,000 pounds of VOC's from the aquifer per year.

Peak Total VOC (TVOC) concentrations observed in the plume were just under 12,000 µg/L in 1989. During the late 1980's the plume extended to MUN-1 and the Great American Knitting Mill (GAKM) located at the foot of Church Street. TVOC concentrations at the 86-4 well cluster were in excess of 3,500 µg/L and concentrations at MUN-1 were approximately 107 µg/L. By 1995 the TVOC concentration at MUN-1 had decreased to 5.2 µg/L and concentrations between MUN-3 and MUN-1 had decreased from hundreds of µg/L to tens of µg/L (Figure 3). The remedial progress can be summarized by the following established contaminant reductions at several key locations:

- Concentrations in the vicinity of the suspected source area have decreased.
- TVOC concentrations in 87-4I have decreased two orders of magnitude from just under 4,000 µg/ L to 36 µg/L.
- TVOC concentrations in 86-3D have decreased by one order of magnitude from just under 1,700 µg/ L to 158 µg/ L.
- Concentrations in the remediation well MUN-3 have decreased by 80 percent from just under 12,000 µg/L (Remcor May 1989) to 2,500 µg/L.
- Concentrations at the former northernmost extent of the plume, MUN-1 have decreased by two orders of magnitude from 107 µg/L to less than the laboratory detection limit. The northern extent of the plume is presently south of the 87-7 well cluster.
- Concentrations in the Southern Area (well 92-17), where a second recovery well had been proposed, have decreased by two orders of magnitude, from greater than 600 µg/L TVOC to 4.3 µg/L.

The points listed above indicate that the originally identified remedy has been successful in controlling the plume and reducing the extent and concentrations of VOCs in groundwater.

1.2.2.1 Summary of air stripper process operations

The remedy identified in the 1989 ROD selected a physical removal process, air stripping, as the best available technology for removing the VOCs from the Bally municipal water supply. Air stripping removes VOCs from water by cascading the water down a tower filled with a complex array of surfaces designed to maximize the surface area of the water as it flows from the top to the bottom of the tower. A constant flow of air is forced upwards through the tower over the water surfaces, causing the VOCs to volatize out of the aqueous state, leaving the water free of the VOCs. Effluent from the system is discharged to an unnamed tributary of the West Branch Perkiomen Creek (West Branch) when MUN-3 is not providing water to the Bally municipal public water system. The treatment system is sampled weekly to ensure that the liquid effluent of the system remains in compliance with the PADEP National Pollutant Discharge Elimination System (NPDES) permit for the system. Additionally, water samples are collected to monitor the air emissions of the treatment system to ensure that concentrations remain within PADEP requirements.

1.2.3 Discovery of 1,4-dioxane in Groundwater

Around 2001 chlorinated solvents were identified in groundwater at a number of industrial and commercial facilities and continuing investigations associated with these facilities, concern arose with regard to solvent stabilizers at such sites. Investigations to evaluate the potential presence of solvent stabilizers were conducted at a number of sites beginning in California in the late 1990s.

In early 2003, in response to the emergence of 1,4-dioxane as a potential COC, a series of special sampling events were conducted at the Site. In February 2003, evaluation samples were collected from MUN-3, Site monitoring wells and a selected set of private monitoring wells. 1,4-Dioxane was detected by the laboratory in MUN-3, and was estimated by the laboratory to be present in one other well below the laboratory reporting limit but above the method detection limit. This was followed by collection of samples at MUN-3 and MUN-1 in early March 2003. Samples were collected from both of these wells and submitted for analysis. While 1,4-dioxane was not detected in MUN-1, it was detected in MUN-3 at a concentration of 30 µg/L. Consequently, in March 2003 a special comprehensive low-flow groundwater sampling event was conducted to evaluate the extent of 1,4-dioxane in groundwater through sampling of Site monitoring wells (ARCADIS, 2003). The analytical results of this sampling event indicated that 1,4-dioxane was present in four of the twenty-eight wells sampled during this event (Appendix A). All four of these wells were located within 300

feet of the former BES facility. Therefore, MUN-3, located less than 700 feet from the facility, is the furthest well with a detection of 1,4-dioxane above the laboratory reporting limit. The distribution of 1, 4-dioxane as indicated by the results of this sampling event combined with date from MUN-1 and MUN-3 indicate that 1,4-dioxane in groundwater is confined to the area between MUN-3 and the former BES facility (Figure 3).

1.2.3.1 Site Activities Due to 1,4-dioxane

In response to the confirmation of 1,4-dioxane in the Bally water supply system USEPA issued an Emergency Administrative Order on Consent (AOC) to Sunbeam dated September 30, 2003. The decree identified a maximum target drinking water groundwater concentration for 1,4-dioxane of 3 µg/L, unless this concentration was not technically feasible. Under those circumstances, a different target concentration could be developed in conjunction with USEPA and PADEP. Additionally the AOC directed Sunbeam to evaluate installing a replacement water supply well as an additional treatment option for groundwater produced by MUN-3. Given the chemical and physical properties of 1,4-dioxane, removal of the compound through air stripping treatment is ineffective.

Because 1,4-dioxane emerged as a new contaminant early in the in the late 1990's and was not identified at the Site until early 2003, relatively little Site data is available for this compound. The following paragraphs provide a discussion of the existing 1,4-dioxane data for the Site.

Beginning in February 2003, and continuing through present, groundwater samples have been collected on at least monthly (and in some cases weekly) intervals from MUN- 3 and analyzed for 1,4-dioxane and VOCs. Presently, groundwater samples are collected from MUN-3 on a weekly basis following air stripping treatment and analyzed for 1,4-dioxane.

Groundwater samples from MUN-3 were analyzed for 1,4-dioxane by Severn Trent Laboratories, Inc. (STL) for the period from February 19, 2003 through January 6, 2005, and by Analytical Laboratory Services, Inc. (ALS) for the February 5 and 12, 2003 events and from February 16, 2005 through the present. The change in analytical laboratories was required to meet an increased sampling frequency requirement mandated by the 2005 NPDES permit Table 1 provides the analytical results for 1,4-dioxane collected from the effluent at MUN-3. Figure 3 depicts the groundwater concentration trends for 1,4-dioxane.

Analytical results for 1,4-dioxane indicated that concentrations of this constituent in effluent groundwater samples ranged from 24 µg/L to 77 µg/L these concentration exceed the proposed groundwater standard of 3 µg/L for this compound for this Site. However, they are below the NPDES permitted concentration of 112 µg/L. In consultation with PADEP, the NPDES permit for 1,4-dioxane discharged to the West Branch was determined to be 112 µg/L. Details on this permit are discussed in greater detail in Section 4.2.

1.2.4 Risk Assessment

As described in the AOC, 3 µg/L was selected as a safe drinking water standard based on a 70-year exposure duration. Assuming a 30-year exposure duration increases the standard to 6 µg/L. Both these values were calculated based on toxicity information available in USEPA's Integrated Risk Information System (IRIS) database. Currently, IRIS lists a cancer slope factor (CSF) for 1,4-dioxane of 1.1×10^{-2}. However, as noted in the FFS work plan, USEPA is actively revising the 1,4-dioxane CSF. The projected date for the next publicly available draft of assessment is November, 2007. Preliminary information, however, indicates that the CSF may change by up to three orders of magnitude. Under these conditions, the drinking water standard could also increase by three orders of magnitude and still provide protection of human health at a 1×10^{-6} risk level.

These findings are consistent with previous risk assessments conducted by ARCADIS for other sites with 1,4-dioxane in groundwater (ARCADIS 2005c). Using the current 1,4-dioxane CSF, a Risk Based Clean-up goal (RBC) of 6 µg/L was calculated assuming a 30-year exposure to drinking water at a risk level of 1×10^{-6}. However, because of the likelihood that the IRIS toxicity values for 1,4-dioxane, which have a direct effect on establishing remediation goals for remedial actions, will be updated by USEPA within the next 12 to 18 months, RBCs for 1,4-dioxane for a range of CSFs can be calculated for the purpose of comparing remedial alternatives for groundwater (ARCADIS, 2005). Assuming that the CSF decreased by one or two orders of magnitude results in RBCs of approximately 60 µg/L and 670 µg/L, respectively, at a 1×10^{-6} risk level. Based upon this information concentrations of 6 µg/L to 670 µg/L are expected to be protective of human health at a risk level of 1×10^{-6}.

1.2.5 Ecological Risk of 1,4-dioxane

Since groundwater effluent from MUN-3 will be discharged to the West Branch, it is also important to consider potential ecological effects. Overall the data indicate that

the range of 1,4-dioxane concentrations typically observed in the effluent (< 70 µg/L) is well below the level of concern for ecological receptors. Previous studies on fathead minnows and other aquatic organisms did not identify adverse effects at concentrations below 6,000 µg/L (SCWD, 2001). The Michigan Department of Environmental Quality (DEQ) has calculated a Final Acute Value (FAV), an Aquatic Maximum Value (AMV), and a Final Chronic Value (FCV) for 1,4-dioxane of 390, 200, and 22 µg/L, respectively. The FCV represents the concentration fish and other aquatic organisms can be continuously exposed to without experiencing any mortality, developmental or reproductive effects. The AMV is the highest concentration to which an aquatic community can be exposed briefly without resulting in unacceptable effects. Effluent concentrations are well below the AMV, but may be slightly above the FCV immediately upon discharge. However, once released into the receiving stream, concentrations of 1,4-dioxane will be immediately diluted to concentrations below the FCV.

Finally, the lack of ecotoxicity from effluent is supported by direct toxicity studies. A report describing acute and chronic toxicity of undiluted effluent from the existing MUN-3 treatment system reported no observable effect on survival or reproduction of Ceriodaphnia dubia or fathead minnows in 100 percent (%) system effluent and serial dilutions of 6.25%, 12.5%, 25% and 50% (CEC, 1994). A calculated Log Bioconcentration Factor was determined to be -0.44. 1,4-Dioxane is not expected to bioconcentrate in fish and other aquatic organisms (Hansch et al, 1985; Howard 1990). As a result, ecological risks are not expected for wildlife feeding on fish and other aquatic organisms exposed to 1,4-dioxane in the treatment system effluent. Under these conditions, toxicity testing or biological community surveys are unnecessary.

1.2.6 Nature and Extent of Contamination

VOC contamination in the Aquifer has been previously delineated as part of the Phase II and Phase III remedial investigations (ERM, 1986; REMCOR, 1989). The extent of 1,4-dioxane contamination was delineated by ARCADIS during the March 2003 Comprehensive Groundwater Sampling event. As shown on Figure 3, the extent of 1,4-dioxane is limited to the area between the former Facility and MUN-3. Additionally the vertical extent of 1,4-dioxane is largely confined to the shallow and intermediate zones with the only Wells 86-3D and MUN-3 exceeding the 3 µg/L criterion.

1.2.7 Fate and Transport

The 1,4-dioxane in the aquifer is limited to the area between the facility and MUN-3. From Figure 3 it is apparent that the highest concentrations of 1,4-dioxane are stretched between the former facility and MUN-3 indicating that transport of 1,4-dioxane is occurring from the former facility to MUN-3 along with the VOCs. Therefore the fate of the 1,4-dioxane in the aquifer is captured through MUN-3.

1,4-Dioxane that is discharged to the unnamed tributary of the West Branch under the present treatment/discharge configuration is attenuated through processes that include photodegradation and dilution. 1,4-Dioxane that may be discharged directly to the West Branch under a future discharge scenario also would be subject to photodegradation, and a much higher degree of dilution due to the relatively high flow rate of the West Branch as compared to the unnamed tributary.

2. Identification of Remedial Action Objectives and ARARs/TBCs

The object of this FFS is to present a description of the problem, identify the relevant legal standards and evaluate other potentially applicable criteria. The sub-sections below identify and describe these items.

2.1 Remedial Action Objectives

Remedial Action Objectives (RAOs) are based upon media specific and general requirements to protect human health and the environment. At the Site the primary exposure pathway is consumption of and dermal exposure to water containing 1,4-dioxane. Therefore, the RAOs for the Site are to discontinue the possible exposure of Bally residents to water containing 1,4-dioxane above the Applicable and Relevant Criteria (ARARs) or To Be Considered (TBC) criteria that have been identified in this report. Furthermore the remedy must continue to provide control of the plume presently undergoing remediation.

2.2 Identification of Applicable Relevant and Appropriate Requirements and To Be Considered Criteria

This section provides an overview of potential ARARs and TBCs, at the federal state, and local levels, which will be used to evaluate remedial alternatives. Table 7 presents the ARARs. Applicable requirements are those clean-up standards, standards of control, or other substantive environmental protection requirements, criteria or

limitations promulgated under federal or state law which specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site. Relevant and appropriate requirements are those federal state, and local requirements which, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well-suited to the particular site and its constituents. TBC standards and guidance are non-promulgated advisories or guidance issued by federal, state, or local agencies that, although not legally binding, can be used in determining the level of clean-up for protection of health or the environment (USEPA, 1988). The 3 µg/L criterion for 1,4-dioxane would therefore fall into the last category.

Further classification of requirements has been developed to provide guidance on identification and compliance with ARARs and TBCs. The three classes include chemical-specific, action-specific, and location-specific.

- Chemical-specific requirements are usually-health or risk-based numerical values or methodologies which, when applied to site-specific conditions, result in the establishment of numerical values. These values establish the acceptable amount or concentration of a chemical that may be found in, or discharged to, the ambient environment.

- Action-specific requirements are usually technology- or activity-based requirements or limitations on actions taken with respect to hazardous wastes.

- Location-specific requirements are restrictions placed on the concentration of hazardous substances or the conduct of activities solely because they occur in special locations. Examples of these special locations include floodplains, wetlands, coastal areas, historic places, and sensitive ecosystems or habitats (USEPA, 1988a).

The COCs in groundwater at the BES site include VOCs and 1,4-dioxane. Chemical-specific ARARs for the VOCs were defined in the ROD based on maximum contaminant levels (MCLs) and water supply permit requirements established by PADEP (USEPA, 1989). Appendix A provides the previously established ARARs for VOCs at the site. As 1,4-dioxane is the only constituent of concern for which ARARs or TBCs have not been established previously for the Site the following paragraphs are limited to the potential requirements for 1,4-dioxane.

Applicable chemical-specific drinking water requirements are not available for 1,4-dioxane for the Bally Site as no MCL has been established by USEPA or PADEP for this compound. A chemical-specific TBC for 1,4-dioxane was developed for the Site as part of the Emergency AOC between USEPA and Sunbeam. The AOC established that any new municipal supply well option or groundwater treatment option for the Borough of Bally should achieve a reduction of the 1,4-dioxane concentration in the Bally PWS to 3 µg/L or, if not practical, feasible and reasonably achievable on a consistent basis, some other concentration approved by USEPA. Therefore, this TBC, while not promulgated under federal or state law, is an applicable chemical-specific requirement for drinking water at the Bally Site and may be considered the governing requirement for 1,4-dioxane concentrations in drinking water.

In addition, PADEP has approved a NPDES permit for discharge of groundwater treatment system effluent containing average monthly concentrations of 1,4-dioxane of 112 µg/L to an approved location along the West Branch. Therefore, the NPDES permit establishes an applicable action-specific ARAR of 112 µg/L for the average monthly discharge concentration and 224 µg/L for the maximum monthly discharge concentration. Preparation of the NPDES permit concentrations includes evaluation of human health effects as well as effects on stream life. Therefore, this 1,4-dioxane concentration is protective of both human and ecological receptors.

PADEP Wetland and Water Encroachment permits have been issued for construction associated with the discharge pipeline. These permits are considered location-specific ARARs.

In addition to these Site-specific TBCs, additional TBCs can be found in health advisory guidance criteria published by USEPA and environmental agencies of other states. Superfund sites where 1,4-dioxane is an issue in several other states were reviewed. However, because USEPA's review of 1,4-dioxane has not been completed, other available criteria regarding 1,4-dioxane were considered. These criteria include the following:

- The initially identified notification level for 1,4-dioxane in California is 3 µg/L (CDHS, 1998). However the response level (the level at which a source should be taken out of service) is 100 times the notification level or 300 µg/L (CDHS, 2006).

- The EPA presently has an immediate action level of 600 µg/L (for 1,4-dioxane). This indicates that in the event that concentrations of 1,4-dioxane greater than 600

µg/L were encountered EPA would take immediate action to address the issue (USEPA, 2004b).

- USEPA Region I and the Connecticut Department of Health have issued an interim drinking water comparison level of 20 µg/L at the Durham Meadows Superfund Site, designed to be protective of the potential cancer and non-cancer effects of 1,4-dioxane (USEPA, 2004a). This concentration updates the previously used 1,4-dioxane RBC of 6.1 µg/L based upon the same IRIS data that was used to generate the 3 µg/L criteria set by the Site AOC.

- USEPA Region II, U.S. Department of Health and the New York State Department of Health have applied the New York State public drinking water standard of 50 µg/L as the appropriate risk level for 1,4-dioxane in drinking water at the Mohonk Industrial Plant Site (USDOH, 2005).

- The MDEQ has revised its generic residential drinking water standard for 1,4-dioxane upward from 3 µg/L to 77 µg/L and then 85 µg/L (SCWD, 2001; MDEQ, 2005). Additionally the acceptable surface water concentration for Michigan is 2,800 µg/L.

Additionally because USEPA required that the installation of a new well be considered as one of the FFS alternatives, criteria of the Delaware River Basin Commission (DRBC), which controls water supply allocations within the Delaware River Basin, were considered. Bally is located at the edge of this basin in an area of lesser concern to the DRBC. However, Bally will be required to justify its water allocation request to the DRBC before being granted an allocation.

3. Remedial Technologies, Technology Screening and Development of Remedial Alternatives

Pursuant to the guidance for FS preparation (USEPA, 1990) this section describes the identification of remedial technologies, the screening of those technologies and the development of remedial alternatives using the identified technologies.

3.1 Identification and Screening of Remedial Technologies

In accordance with the requirements of the AOC, two general approaches were reviewed: 1) replacement of the existing drinking water supply source and 2) treatment of the existing drinking water supply to achieve a reduction of the 1,4-dioxane

concentrations in the Bally PWS to 3 µg/L or, if not practical and feasibly and reasonably achievable on a consistent basis, some other concentration approved by USEPA.

Remedial technologies are not applicable for the installation of a new municipal supply well, as this activity is not expected to increase treatment of extracted water beyond the chlorination that is typically conducted for water supply systems. Therefore the remedial technologies described in this section are discussed in terms of treatment of water extracted from MUN-3 for use in the Bally municipal water supply system.

The chemical characteristics of 1,4-dioxane limit the available treatment technologies for the purpose of supplying drinking water to the Bally water supply system. Table 3 provides the results of the initial technology screening conducted by ARCADIS. For the purposes of this document, as stated in the FFS Work Plan, only Advanced Oxidation Processes (AOP) will be considered as a treatment method.

3.1.1 Ozone-Catalyzed Hydrogen Peroxide (O_3/H_2O_2) Oxidation

Ozone-catalyzed hydrogen peroxide oxidation utilizes ozone (O_3) and hydrogen peroxide (H_2O_2) for the degradation of organics in water. H_2O_2 is typically mixed into the influent treatment stream prior to entering a baffled O_3 reactor. Upon contact with H_2O_2, sparged O_3 in the reactor catalyzes the production of hydroxyl radicals ($^{\bullet}OH$) for the oxidation process. Hydroxyl radical available for oxidation can be tailored to the contaminant concentration by adjusting the influent O_3/H_2O_2 concentrations. After sufficient contact time, water from the reactor is collected for disposal. Unit processes involved in this remedial approach include an O_3 generator, the reaction vessel, and a catalytic O_3 decomposer to scavenge unreacted dissolved O_3. Because of the additional logistics and the operational costs associated with this option, it was not effective in comparison with other available technologies.

3.1.2 Oxidation via Direct Ozonation

Oxidation via direct ozonation is similar to the oxidation process discussed above in that O_3 is sparged into a reaction vessel for the oxidation of dissolved organic contaminants. The absence of a catalyst [e.g. Ultra Violet (UV) radiation, H_2O_2] in this process, however, increases the necessary retention time for complete degradation. Due to the long reaction times as well as the high costs associated with O_3 treatment apparatus, this alternative was not retained for further analysis.

3.1.3 Titanium Dioxide (TiO_2) Photocatalytic Oxidation

Titanium dioxide photocatalytic oxidation typically utilizes flow-through photocatalytic reactor cells which are each surrounded with a TiO_2/fiberglass mesh. A UV light source is located coaxially to the flow through cells, and contact with bound TiO_2generates available electrons at the mesh surface. Water passing across this interface will dissociate to form $^{\bullet}OH$ and superoxide ($O_2^{\bullet-}$). While this technology has been identified as being potentially cost effective, it was ruled out for use in a municipal water supply setting for the following reasons:

- This is a relatively new technology and standardized operation procedures have not been thoroughly established for a municipal setting.

- The catalyst media used in the treatment process must be recaptured, recycled, and then replaced following treatment.

3.1.4 UV/Hydrogen Peroxide Oxidation

Oxidation with UV radiation and H_2O_2 is a conventional approach for the removal of organic contaminants. Generally, treatment systems produce no sludge, spent waste, or air emissions that require additional handling or disposal. Similar to the technologies discussed above, the oxidation process occurs in a series of flow-through reaction cells each which is equipped with a UV light source. H_2O_2 is supplied to the influent treatment stream, and photolysis with UV radiation creates dissolved $^{\bullet}OH$. Typically, acid is also supplied to the influent stream to decrease pH during the oxidation process; pH is then neutralized in the effluent stream after treatment. Unit operations involved in this technology include an H_2O_2 supply unit, acid base supply vessels, and the UV oxidation flow-through units. Dissolved metals (iron, manganese) in the treatment stream may also become oxidized during this process, and periodic cleaning of the flow through cells may be necessary during operation and maintenance (O&M) activities to maintain treatment efficiency. This treatment strategy is commonly used for disinfection in municipal systems and is more cost effective than other available technologies. This approach was therefore selected for further consideration.

3.2 Development of Remedial Alternatives

Remedial technologies and process options retained during the preliminary technology evaluation and screening (Section 3.1) are assembled in this section into prescribed remedial actions and remedial action alternatives for the Bally water supply system.

Each includes a description of the remedial action or alternative, including a conceptual design for implementation and a discussion of the assumptions made, which will provide a basis for detailed analysis and comparison to other alternatives. Section 4 presents a detailed and comparative analysis of the remedial actions and alternatives developed in this section.

3.2.1 *Alternative 1: Installation of a New Groundwater Source*

Alternative 1 will allow the delivery of a clean water supply via the installation of a new municipal well. As detailed in Section 4.2, characterization activities and pumping tests were conducted on the Bally aquifer to verify the feasibility of this alternative. Air stripping activities have been effective in treating the dissolved VOC plume and operation of the system in place at MUN-3 will continue. Additionally, this alternative will incorporate the installation of a new discharge pipeline to deliver the treatment system effluent to the West Branch. Long-term monitoring, as included in the current permit, will include monthly system sampling at MUN-3. In addition, long term monitoring of monitoring wells located in the vicinity of the Bally Site as well will be performed to verify the attenuation of the plume over time as well as verifying that pumping of the new well does not adversely impact the extent of the plume. In addition a series of contingency actions to address potential plume stability issues has been established with the input of EPA. The contingency plan is somewhat dynamic but includes actions such as increasing the pumping rate at MUN-3 and activation of cut off pumping at MUN-1. A final version of the plume monitoring program and contingency plan will be submitted to EPA for approval.

3.2.2 Alternative 2: Additional Treatment at MUN-3 Using Advanced Oxidation Processes

Alternative 2 involves the continued use of MUN-3 as the primary water supply well in Bally. Operation of the air stripping system will continue for VOC removal, but the existing system will be retrofitted with a UV/H_2O_2 treatment unit for the oxidation of 1,4-dioxane after passing through the air stripper. Discharge water from the air stripper will be mixed with H_2O_2 prior to entering the UV reactor. The necessary system flow rate, treatment unit sizing, and UV/ H_2O_2 dosing requirements will be finalized during the remedial design phase. Water discharged from the treatment system will be delivered as necessary to either the public water supply or the unnamed tributary outfall, as currently conducted. Long-term monitoring, as included under the existing permit, will include monthly system sampling at MUN-3. In addition, monitoring wells located in the vicinity of the Site as well will be monitored to verify the attenuation of the plume over time.

To be conservative, operation of the groundwater treatment system will be conducted for 30 years or until remedial goals have been achieved within the plume area. System and groundwater monitoring well sampling will also be conducted within this time frame.

4. Detailed Analysis of Alternatives

This section describes in detail each of the identified remedies to support the comparative analysis presented in Section 5.1

4.1 Remedial Alternative Screening Criteria

Per EPA guidance the following sections present each of the alternatives and evaluate the alternatives against the following nine criteria:

- Threshold Criteria – These provide the statutory requirements that the alternative must satisfy in order to be eligible for selection.
  - Overall protection of human health and the environment;
  - Compliance with ARARs;
- Balancing Criteria – These are the primary evaluation criteria on which the technical qualities of the alternatives are compared.
  - Long-term effectiveness and permanence;
  - Reduction of toxicity, mobility or volume through treatment;
  - Short-term effectiveness;
  - Implementablity;
  - Cost;
- Modifying Criteria – These are formally addressed during the public comment period.
  - State/ support agency acceptance; and,
  - Community acceptance.

The following sections present the comparison of each of these remedial options to the above criteria. A comparative analysis of the alternatives was performed based on these criteria. The results are presented in Section 5.1.

4.2 Bally Groundwater Treatment Alternatives Analysis

4.2.1 *Alternative 1 – Installation of a New Groundwater Source*

Alternative 1 includes the following required components: 1) a new municipal supply well: 2) continued air stripping treatment at MUN-3; and, 3) discharge of MUN-3 effluent to the West Branch. Figure 6 presents the major required components of this alternative.

4.2.1.1 Installation and Operation of New Municipal Supply Well

From 2003 through 2006, Sunbeam performed investigative work in cooperation with PADEP, USEPA, and Bally representatives to identify, test, and evaluate a suitable well site to provide a new municipal water supply well for Bally. Potential properties were initially identified based upon the fracture trace analyses performed by ARCADIS and the USEPA (EPIC, 1992). Ultimately the investigation was also driven by the ability to gain access to various properties. Access to one property has been achieved through an access agreement with the property owner and control of the required PADEP required Zone 1 Well Head Protection Area (WHPA) has been secured. A detailed investigation of the well site, including installation and testing of the proposed production well, PW-01, indicated that the well site will yield an acceptable quantity of drinking water to serve as a community water supply source for Bally. The results of the investigation were provided to PADEP and USEPA in the March 2006 Detailed Hydrogeologic Water Resources Investigation (WRI) (ARCADIS, 2006).

The proposed municipal supply well, PW-01, is located on a 2.5 acre parcel (Well Site) approximately 1,500 feet northeast of the northeastern Bally boundary, in an agricultural setting on a 40-acre privately-owned property (Property). Land use immediately surrounding the Property is residential and agricultural. PW-01 is supplied by an unimpacted aquifer region approximately 4,500 feet from the identified plume area that is pumped from MUN-3 to the southwest, and more than 3 miles from the Crossley Farm Superfund site located to the northeast well into the Reading Hills.

Groundwater flow in the region occurs largely in a southeasterly direction, approximately normal to the orientation of the Reading Prong. Flow moves from the relatively discrete fracture and recharge areas in the steep basins of the hills down through the Leithsville and Hardyston formations, and into deposits of the Newark Basin. The area where the investigation was conducted was predominantly within the limits of the Leithsville formation and centered on the wedge of dolostone located

between the mapped locations of the Precambrian gneiss and the Newark Basin. Groundwater occurrence in the dolostone is variable as is typical of a karstic aquifer. Drilling data indicates that the Leithsville formation has features typical of karstic carbonate rock such as solution channels and significant secondary porosity.

Aquifer characterization included several tiers of testing culminating in an 8-day aquifer test conducted at 350 gallons per minute (gpm). Previous levels of testing included a 48-hour test and a 54-hour test. The 48-hour constant rate test conducted at 160 gpm was conducted in June 2005. The 54-hour constant rate (350 gpm) pumping test on PW-01 was conducted in October 2005 and established that PW-01 could support a discharge rate of 350 gpm for an extended period and that this was an appropriate rate for a final aquifer test. In December 2005, a final 8-day constant rate (350 gpm) pumping test developed in consultation with USEPA was conducted on PW-01 to meet the requirements for a new groundwater community water supply source set forth by PADEP and the Delaware River Basin Commission (DRBC).

The results of the aquifer testing program indicated PW-01 was completed in an exceptional fault aquifer system with above average groundwater storage and transmission potential as attested by a high specific capacity of PW-01 (2.6 gpm/ft), and in broader terms a relatively high aquifer transmissivity. In an average precipitation year, a 350 gpm withdrawal rate sustained for over a week is expected to result in approximately 220 feet of remaining available drawdown in the well and as much as 270 feet in the immediate surrounding aquifer and although the 8-day test identified that PW-01 interferes with MUN-3, this interference has no material effect on the yield of PW-01. Additionally the 90% or better recovery of the well in less than an hour further supports the capacity of the aquifer system. It should also be noted that the 8-day specific capacity of PW-01 was approximately twice that of MUN-3, suggesting that PW-01 is a much more efficient well than MUN-3. Additionally the proven sustainable production rate of PW-01 is approximately three times the 2026 projected water demand for Bally based upon the demand increase from the mid-1980s to present. Over that period Bally's average water demand increased from approximately 50 gpm to approximately 85 gpm. A linear increase over the next twenty years would indicate a 2026 water demand of approximately 136 gpm. Tripling the rate of growth would result in a 2026 water demand of approximately 238 gpm.

To evaluate the long term sustainability of the yield of PW-01 and to determine the magnitude of interference between PW-01 and MUN-3, late time drawdown from four key wells (including PW-01) was projected out to anticipate the effect of six months of pumping with no recharge. This analysis suggested that a total of approximately 110

to 120 feet of drawdown would occur at well PW-01 following six months of pumping with no recharge, leaving greater than 200 feet of available drawdown remaining. The projections indicate that the yield at PW-01 is sustainable and that a durable groundwater divide exists in the approximate vicinity of MUN-1. This divide will remain when wells PW-01 and MUN-3 are operated simultaneously (ARCADIS, 2006).

To assure that the long term operation of PW-01 does not promote adverse migration of the existing chlorinated VOC plume towards the well, preventive measures have been defined to first allow assessment of any plume changes, and then secondly to outline a course of action to mitigate any plume movement. In addition to the required PADEP Community Water Source Monitoring, and the existing groundwater monitoring program for the plume, sentry well monitoring activities will be conducted at four existing wells and one new well located in the area between MUN-3 and PW-01.

To assure that the long term operation of PW-01 does not promote adverse migration of the existing chlorinated VOC plume towards well PW-01, preventive measures have been defined to first allow assessment of any plume changes, and then secondly to outline a course of action to mitigate any plume movement. These measures include the plume monitoring program and contingency plan which will be formally proposed to the USEPA for review and approval during the remedial design process. USEPA and ARCADIS conducted a work session in September 2006 to review future groundwater monitoring plans (installation of additional deep monitoring well MW-07, etc.). Additional work sessions to discuss the details of plume monitoring will be conducted as necessary.

The sentry monitoring program will be established under approval the USEPA. Sentry well monitoring will be conducted monthly, quarterly, and semiannually for the first, second, and third years, respectively, following initiation of pumping at PW-01 and then will be rolled into the existing semi-annual groundwater monitoring program for the plume. In the event that the periodic monitoring program indicates that the plume is migrating towards PW-01, the two most likely responses are as follows: (a) the pumping rate at MUN-3 could be increased in order to expand the capture zone of MUN-3, and (b) a pumping program could be instituted at MUN-1, located between MUN-3 and PW-01, to provide an effective cutoff of concentrations of VOCs escaping the capture zone of MUN-3. The two options presented above should be sufficient, either each by itself or in some combination, to control migration of the plume towards PW-01. However, based upon the results of the testing that has been conducted to date, plume migration is not expected.

To determine if the aquifer at the Well Site meets drinking water quality standards, groundwater samples were collected during the June 2005 and December 2005 pumping tests and analyzed for parameters in accordance with the PADEP new source sampling requirements for community groundwater sources (PADEP, 1998), 1,4-dioxane, and micro-particulates. Analytical results indicated no constituents were detected above PADEP MCLs for Community Groundwater Sources, for those constituents for which MCLs have been defined by PADEP. PADEP and USEPA have not established an MCL for 1,4-dioxane, and 1,4-dioxane was not detected above the laboratory detection limit in any sample collected from the Well Site. The micro-particulate analyte (MPA) samples are required to be collected where the potential exists for water to be drawn from surface water into the well. Analytical results indicated no particulates were identified. However, per PADEP requirements the well will have to undergo a six-month special monitoring program for the Surface Water Identification Procedure (SWIP) in addition to standard requirements for public water supply quality monitoring.

As part of this alternative evaluation an analysis was conducted to assess the integrity of the Bally potable water system for different pressurization regimes. These analyses were conducted by Bally's consultant for system operation, System Design Engineering (SDE). Analyses were run to evaluate pressurization of the system from different connection points including the north end of Bally where the planned connection point for the new system is located (Figure 6). The analyses indicated that the selected connection point generally provided equal or better system performance than the present connection at MUN-3.

The additional components of the Bally municipal water system required by this remedy will be constructed in accordance with the PADEP requirements for community water supply systems as described in the PADEP Public Water Supply Manual Part II Community System Design Standards The completed replacement well and associated components would be formally transferred to Bally following a one year warranty period. Thereafter, Bally would be responsible for upkeep and maintenance of the new system components. Once the appropriate regulatory approvals have been obtained, ARCADIS will begin final construction of the additional system components.

4.2.1.2 Continued Air Stripping Treatment at MUN-3

The air stripping treatment system at MUN-3 has been shown to be effective in treating the plume for VOCs. In the event a new municipal supply well is implemented, MUN-3

will continue to operate with the same treatment and sampling protocol currently in place as described in the ROD.

4.2.1.3 Pipeline Construction and Utilization to Discharge MUN-3 Effluent to West Branch Perkiomen Creek

Implementation of this alternative will require the construction of a new pipeline to discharge air stripper treatment system effluent to a PADEP approved location along the West Branch. The new location along the West Branch has greater channel flow and mixing capacity than the current discharge location. The PADEP has approved an NPDES permit for the treatment system effluent for a 1,4-dioxane concentration of 112 µg/L. Historical effluent concentrations for 1,4-dioxane have been well below this value.

4.2.2 Criteria Assessment for Alternative 1

The following sections provide an evaluation of the nine criteria that must be evaluated as part of the remedy selection process.

4.2.2.1 Overall Protection of Human Health and the Environment

This alternative is protective of human health and the environment. The new public water supply will be sourced from an unimpacted aquifer region with demonstrated drinking water quality based on ARARs and proven sustainable yield based on aquifer testing. Assurance that pumping at the production well is not inducing migration of the identified plume toward the production well will be achieved through a sentry well monitoring program, which has been designed in conjunction with USEPA. While aquifer testing indicates plume migration is highly unlikely, viable options are available to counterbalance the effects of pumping at the production well and prevent impact to the drinking water supply in the event plume migration is observed. Historical Site data indicates that it would take in the range of 2-7 years for the plume to migrate from the 86-5 cluster to MW-04 if MUN-3 was not pumping. Treatment of the plume through air stripping at MUN-3 has proven to be effective at reducing concentrations of VOCs to meet the established ARARs, and this treatment strategy will continue for this alternative. The approved new discharge location along the West Branch Perkiomen Creek has an appropriate channel flow to safely accommodate the expected 1,4-dioxane effluent concentrations through dilution/mixing.

4.2.2.2 Compliance with ARARs

This alternative complies with the regulatory requirements for drinking water and discharge to surface water. A permit from the PADEP's Water Supply and Management Section to operate the new public water supply well is an applicable regulatory requirement. Monitoring of 1,4-dioxane effluent concentrations will be conducted in accordance with the NPDES permit requirement. Drinking water ARARs for constituents that are required to be analyzed under PADEP new source sampling requirements are based on the respective MCLs for these constituents. The drinking water ARAR for 1,4-dioxane is based on the AOC which proposes a target of 3 µg/L. The Well Site is located in an unimpacted aquifer region beyond the limits of the identified plume. Analysis of groundwater sampling collected at the Well Site and from wells located nearly a mile to the southwest (towards the Site) indicated that no constituents were present above their respective ARARs. Operation of the public water supply system will require continued periodic water quality monitoring to ensure drinking water ARARs continue to be met. The discharge to surface water ARAR for 1,4-dioxane is 112 µg/L, based on the NPDES permit for the treatment effluent. Effluent concentrations of 1,4-dioxane at MUN-3 have historically been significantly below the ARAR and similar or declining levels are expected in the future. Monitoring of 1,4-dioxane effluent concentrations will be conducted periodically.

4.2.2.3 Long-term Effectiveness and Permanence

The new municipal supply well will be located in a portion of the aquifer located sidegradient to slightly upgradient of the Site. Water quality in the aquifer at the Well Site has been shown to meet the PADEP requirements for community water supply sources. Therefore, no treatment is anticipated beyond chlorination typical of any public water supply. Sunbeam will assist in the operation of the well for a one year warranty period after which Bally will take sole responsibility for the operation of the new well. This period will be used to ensure the proper mechanical operation of the well according to industry standards. The long-term success of this alternative will be dependent on the absence of plume capture by PW-01 and on the sustainable yield of the aquifer. Aquifer testing indicates that plume migration is not expected. As stated above, periodic sentry monitoring will be conducted to provide ample warning if plume migration does occur towards PW-01. Additionally, response strategies have been developed in the unlikely event that migration should occur. Based on the results of three pumping tests conducted at the Well Site, PW-01 was completed in an exceptional fault aquifer system and aquifer specific capacity, recovery rate, and late time drawdown projections indicate the 350 gpm yield at PW-01 is sustainable.

Discharge of the treatment effluent from MUN-3 to an approved location along the West Branch will enable dilution of residual concentrations of 1,4-dioxane to surface water concentrations in compliance with the PADEP issued NPDES requirements and ultimately a drinking water criterion of 3 µg/L. Concentrations of 1,4-dioxane in the effluent will continue to be monitored periodically to ensure that concentrations do not exceed the surface water ARAR

4.2.2.4 Reduction of Toxicity, Mobility or Volume through Treatment

Reduction of toxicity of 1,4-dioxane involves transfer of the contaminant mass from the groundwater to a surface water body with sufficient mixing capacity to safely accommodate the contaminant mass. Reduction of toxicity is, therefore, achieved by discharge to the West Branch. The maximum allowable effluent concentration of 1,4-dioxane discharged to the stream is 112 µg/L, based on an approved NPDES permit. Concentrations of 1,4-dioxane in effluent samples collected from MUN-3 from February 2003 through September, 2006 ranged from 24 µg/L to 77 µg/L. As these concentrations are already below the NPDES permitted effluent concentrations no additional treatment of 1,4-dioxane is required prior to discharging to the stream.

4.2.2.5 Short-term Effectiveness

The location of the proposed pumping well (PW-01) is outside of the extent of the identified groundwater plume. Therefore, the process of development of this well as a public water supply source will not introduce hazards to human health or the environment which exceed the normal hazards of constructing a public supply well facility. The estimated time to completion of a permitted new public water supply system is approximately one year, which includes securing the necessary permits and construction of the pumping well facility and distribution infrastructure. Bottled water will continue to be supplied to Bally municipal water system users during the permitting and construction period.

1,4-Dioxane contained in the effluent from MUN-3 will continue to be discharged at the present discharge location along the West Branch Perkiomen Creek and will not present an exposure hazard to workers during construction of the new pipeline. The environmental impact of pipeline construction includes wetland areas that will have to be crossed. Based upon the results of the evaluation, it is recommended that a certified bog turtle habitat evaluator be present during construction in the previously delimited potential habitat area (ASG, 2004). The estimated construction time for the pipeline is 3 months. At the time of publication of this report the Pennsylvania

Department of Transportation (PennDOT) permit was the only permit remaining outstanding. Once construction of the discharge pipeline is complete, effluent from MUN-3 can be discharged to the new location along the West Branch, regardless of construction status of the new public water supply.

4.2.2.6 Implementability

Completion of well PW-01 as a public water supply source and construction of the associated distribution infrastructure will involve standard technical procedures and materials with regulatory standards guiding implementation. Aquifer testing for the proposed Well Site has indicated that PW-01 is capable of sustainably supplying 350 gpm of drinking water, which will be more than sufficient to meet the anticipated water supply need. Water quality monitoring of the production well will be conducted in accordance with PADEP Community Water Source Monitoring, SWIP Monitoring, and the proposed sentry well monitoring plan, and will employ approved sampling protocol. The implementation of this alternative will also require additional permitting from state and local governing agencies prior to its construction and operation.

Construction of the discharge pipeline will be based on standard engineering design practices and utilize standard material and components. Monitoring of 1,4-dioxane concentrations in MUN-3 effluent will continue in accordance with the requirements of the NPDES permit to ensure that concentrations of 1,4-dioxane do not exceed the NPDES permitted effluent concentration of 112 µg/L, and will employ approved sampling procedures.

4.2.2.7 Cost

The estimated costs for implementation of this alternative are presented in Table 4. This cost estimate includes costs for the design, permitting and installation of the discharge pipeline, the new supply well and associated structures and the additional supply piping to connect the new well to the present system. The anticipated total costs for these activities are $3,266,000. Some of these costs have already been incurred by Sunbeam.

4.2.2.8 State and Support Agency Acceptance

State and support agency acceptance will be formally addressed following the submission of this report.

4.2.2.9 Community Acceptance

This will be formally addressed during the public comment period. However this alternative has a high likelihood of community acceptance. In a meeting with EPA representatives on August 28, 2006 the Borough council approved the plan to proceed with the new well.

4.2.3 Alternative 2 – Additional Treatment at MUN-3 Using Advanced Oxidation Processes

Under this Alternative 2, MUN- 3 would continue to operate and serve as a water source for the Bally PWS. The existing air stripper treatment system at MUN- 3 would also continue operating to remove VOCs present in the extracted groundwater. The water exiting the air stripper system would undergo an additional treatment step utilizing an advanced oxidation process (AOP) to chemically destroy the 1,4-dioxane present in the extracted groundwater. Figure 7 presents a system schematic of the present treatment system as it would be expanded to incorporate Alternative 2. The USEPA and PADEP have proposed a criterion of 3 µg/L as the target for the Bally PWS.

A comprehensive review of available remedial technologies to treat 1,4-dioxane in groundwater indicated that the best available technologies (BAT) for treatment of 1,4-dioxane under the relatively high flow regime existing at the Bally public water supply (PWS) are gaseous ozone (ozonation) and ultraviolet light/hydrogen peroxide (UV/peroxide) treatment. Other treatment technologies and variations of advanced oxidation processes (AOPs) exist, but are less attractive for a variety of reasons, including a lack of performance history and data for high flow regimes.

As described in an ARCADIS letter to the USEPA, Region III, dated 20 August 2003, (2003b) ARCADIS performed an evaluation of 1,4-dioxane treatment for the Bally PWS. 2003. As part of this evaluation, ARCADIS surveyed multiple vendors, operators and regulators of 1,4-dioxane treatment systems to assess other parties' experiences with treatment technologies. This evaluation also included bench-scale testing of the ozonation and UV/peroxide technologies on water samples collected from MUN- 3. These water samples were collected in March, April and June 2003 at a collection point located after air stripping but prior to chlorination.

The ozonation testing was performed by Michigan State University (MSU) and the UV/peroxide testing was performed by Trojan Technologies, Inc. (Trojan). Bench scale testing results included the following:

- The ozonation process reduced 1,4-dioxane concentrations from 60 µg/L to less than 1 µg/L after fifteen minutes of contact time with a 5% ozone feed into one liter of water;

- The UV/peroxide process reduced 1,4-dioxane concentrations from approximately 290 µg/L (a sample that was spiked with additional 1,4-dioxane) to less than 30 µg/L after 120 minutes of contact time using a 30-watt UV lamp;

- The ozonation process left a by-product residual of 13 µg/L of formaldehyde and 60 µg/L of bromate after fifteen minutes of contact time; and,

- The UV/peroxide process left a by-product residual of 42 µg/L of formaldehyde and no bromate in an un-spiked sample.

The evaluation found that there is a limited body of data on the effectiveness, performance, and practicability of ozonation and UV/peroxide treatment systems that treat for 1,4-dioxane. This limited data does not allow for a confident extrapolation of performance results to a system like the Bally PWS.

Of the fourteen treatment system regulators, vendors and operators that were identified and contacted for this evaluation, only one instance was found where an operating treatment system discharged water directly to a PWS. 1,4-Dioxane was not the primary contaminant of concern at this site, and the influent 1,4-dioxane concentrations for that treatment system were typically less than 3 µg/L. Over an order of magnitude lower than the concentrations typically detected at MUN- 3.

Systems with similar or higher concentrations of 1,4-dioxane as MUN- 3 did not discharge directly to a PWS and/or were configured in a manner that would be impractical for the Bally PWS. As such, there is no history of consistent treatment to 3 µg/L or less for influent 1,4-dioxane concentrations and flow rates similar to those observed at MUN- 3 and for a PWS similar to the Bally PWS.

4.2.3.1 Criteria Assessment for Alternative 2

The following sections provide and evaluation of the nine criteria that must be evaluated as part of the remedy selection process.

4.2.3.2 Overall Protection of Human Health and the Environment

This alternative is protective of human health and the environment with regards to exposure to 1,4-dioxane. This alternative would remove the 1,4-dioxane present in groundwater extracted at MUN- 3 by chemical destruction. However, residuals such as bromate and formaldehyde can form during treatment by ozonation or UV/peroxide. Avoidance of such byproduct formation would need to be guaranteed for any treatment system for MUN- 3.

During the bench-scale testing mentioned above, bromate was detected in water treated by ozonation at concentrations of approximately 50 to 60 µg/L. These concentrations are above the USEPA and PADEP MCL of 10 µg/L. Formaldehyde was detected in both water treated by ozonation and water treated by UV/peroxide. There is currently no MCL for formaldehyde. However, the USEPA has identified health concerns associated with the consumption of drinking water containing formaldehyde. ARCADIS' treatment technology evaluation found that consistent byproducts testing for compounds such as bromate and formaldehyde generally was not conducted in operating treatment systems. As such, ARCADIS' evaluation found that a definitive history of systems with documented absence of treatment byproducts that would be adequate for extrapolation to MUN- 3 was not clearly evident.

Further testing of 1,4-dioxane treatment systems would have to be performed because of the generation of potentially harmful treatment byproducts. This would include further bench-scale testing in addition to conducting pilot-scale testing prior to implementation of a full-scale treatment system at MUN- 3.

4.2.3.3 Compliance with ARARs

This alternative may not comply with the site related ARARs for drinking water and discharge to surface water due to the substantial possibility that production of bromate or formaldehyde may occur. The most stringent drinking water TBC for 1,4-dioxane is based on a proposed target of 3 µg/L for this compound for the Site. Based upon the evaluation of the treatment system performance described above, consistent achievement of 1,4-dioxane concentrations below 3 µg/L may not be feasible.

4.2.3.4 Long-Term Effectiveness and Performance

Alternative 2 would not provide an effective long-term remedy for the presence of 1,4-dioxane in groundwater extracted from MUN-3. This alternative would remove 1,4-

dioxane from groundwater extracted at MUN- 3 because this alternative would chemically destroy the 1,4-dioxane. Under these conditions, the amount of 1,4-dioxane that would enter the Bally PWS and the nearby receiving stream would be greatly reduced. However, the ability of a treatment system to consistently meet a 3 µg/L treatment threshold is uncertain. In addition, there is a possibility that undesirable byproducts would be produced. Therefore, given the present state of the treatment technologies available, this alternative would not be effective if implemented.

This alternative would incur significant ongoing operating and maintenance costs, and a long-term operation and maintenance program would have to be implemented for this alternative to ensure that the AOP treatment system is working properly. Monitoring for treatment byproducts may also have to be implemented depending on the results of additional studies and the AOP treatment system chosen. However, the addition of a treatment system at MUN- 3 would also provide the infrastructure to upgrade the treatment in the event that better technology is developed in the future.

4.2.3.5 Reduction of Mobility, Toxicity, or Volume

This alternative utilizes AOPs that can chemically destroy the 1,4-dioxane in groundwater that is extracted from MUN- 3. Therefore, this treatment technology reduces the mobility, toxicity, and volume of 1,4-dioxane. However, as noted above, undesirable residual reaction byproducts may be present in the treated effluent. AOP treatment may result in the formation of bromate and or formaldehyde as reaction byproducts that are not presently in the treatment system effluent.

4.2.3.6 Short-Term Effectiveness

Following the additional pilot study work that would have to be performed prior to implementation, an AOP treatment system will be able to meet its objectives for 1,4-dioxane removal relatively quickly. The permitting and construction of a treatment system at MUN- 3 will take several months. Construction would not impact any undeveloped land and would occur entirely on property owned by the Borough of Bally. Once activated, the treatment system would be able to reduce 1,4-dioxane concentrations immediately. However, the ability of the treatment system to consistently reduce 1,4-dioxane below 3 µg/L is uncertain without further testing. Workers would not be exposed to any groundwater contaminants throughout most of construction.

4.2.3.7 Implementability

Prior to construction of the full-scale AOP treatment system, a pilot test would have to be performed to further evaluate the treatment technology. More extensive pilot testing would be required in order to use this technology for drinking water treatment. Once a successful pilot test has been conducted, this technology could be readily put into place due to its modularity. This alternative would require the expansion of the existing facilities at MUN- 3, such as the electrical service, in order to accommodate the installation and operation of the treatment system. The implementation of this alternative would also require additional permitting from state and local governing agencies prior to its construction and operation.

4.2.3.8 Cost

The estimated costs for implementation of this alternative are provided in Table 5. This cost estimate assumes that UV/peroxide treatment would be the AOP utilized at MUN-3. These costs include a pilot study, the construction of a building and electrical service to accommodate the UV/peroxide treatment system, the treatment system components and controls, and thirty years of operation and maintenance costs for the treatment system. The estimated cost for this option is approximately $4,373,000.

4.2.3.9 State/Support Agency Acceptance

Present indications are that the USEPA and PADEP would prefer another remedy; however, State and support agency acceptance will be formally addressed following the submission of this report.

4.2.3.10 Community Acceptance

A Bally Borough official has indicated that additional treatment at MUN-3 would not be acceptable to the Bally Borough Council. However, this aspect will be formally addressed during the public comment period.

5. Recommended Alternative

Installation of a new groundwater source has been identified as the best option under the presently existing conditions. The following sections compare Alternatives 1 and 2 as implementable remedies.

5.1 Comparative Analysis of Options

Both Alternatives 1 and 2 provide solutions that would provide an implementable long term solution to remove 1,4-dioxane from the Bally PWS. However, in the short term Alternative 1 is more effective as this alternative does not require the additional bench and pilot scale testing required as part of Alternative 2 are unnecessary. Therefore it is anticipated that Alternative 1 would provide 1,4-dioxane free water flowing to Bally residents sooner than Alternative 2.

Analysis indicates that Alternative 2 would provide a greater reduction of toxicity, volume and mobility of 1,4-dioxane as it would destroy the chemical structure of the 1,4-dioxane molecule. However, Alternative 2 may also produce undesirable byproducts. Alternative 1 would not directly destroy the 1,4-dioxane molecule. However, it would place the 1,4-dioxane in a situation where it can be more readily degraded by natural processes. Dilution/mixing would instantly decrease the concentration of 1,4-dioxane below 3 µg/L.

Alternative 1 can be more readily implemented than can Alternative 2 as it is founded upon established technology and will provide Bally with a system that is equivalent or simpler (to operate) than its present water supply system. Additionally, system maintenance and repairs when required would not typically require highly specialized training as would Alternative 2.

A cost comparison of Alternatives 1 and 2 is presented in Table 6. This table reveals that while Alternative 1 requires more than twice the initial capital cost outlay, the annual O&M costs for Alternative 1 are approximately one quarter of the Alternative 2 annual O&M costs. Therefore, the total cost for Alternative 1 is significantly lower than Alternative 2 over the period of operation.

5.2 Recommended Alternative

Given all of the above factors, Alternative 1 is the recommended option to address the 1,4-dioxane concentrations in the Bally PWS.

6. References

AMY S. GREENE ENVIRONMENTAL CONSULTANTS, INC. 2004, Wetland Delineation Report for the Proposed Groundwater Treatment System Discharge

Pipeline Route, Bally Borough and Washington Township Berks County, Pennsylvania, December 2004.

ARCADIS 2003a, June 2003, Groundwater Monitoring Report, March 2003 Groundwater Sampling Event, Bally Groundwater Contamination Superfund Site, Bally Borough, Berks County, Pennsylvania.

ARCADIS, 2003b, August 20, 2003, Letter, "Evaluation of 1,4-dioxane Treatment for the Bally Drinking water Supply System, Bally Groundwater Contamination Site, Bally, Pennsylvania".

ARCADIS, May 2005a, Focused Feasibility Study Work Plan, Bally Groundwater Contamination Superfund Site, Bally Borough, Berks County, Pennsylvania.

ARCADIS, December 2005b, Feasibility Study, CAMOR Site, Westville, Indiana.

ARCADIS, September 2005c, Remedial Investigation Report, CAMOR Site, Westville Indiana.

ARCADIS 2005C July 2005, Remedial Action Status Report (Letter), Bally Groundwater Contamination Site, Bally Borough, Berks County, Pennsylvania.

ARCADIS, March 2006a, Detailed Investigation Water Resources Investigation Report, Bally Groundwater Contamination Superfund Site, Bally Borough, Berks County, Pennsylvania.

California Department of Health Services, 1998, Memorandum for 1,4-dioxane Action Level, Sacramento, California, March, 24, 1998.

California Department of Health Services, 2006, Drinking Water Notification Levels and Response Levels, June 28, 2006.

CEC, 2002. Pre-Drilling Plan for Installation of Back-up Municipal Supply Well, Borough of Bally, Berks County, Pennsylvania.

CEC, 1994. Pre-Design Report Bally Groundwater Contamination Site, Borough of Bally, Berks County, Pennsylvania June 6, 1994)

Hansch, C., A.J. Leo, 1985. Medchem Project Issue No. 26 Claremont, CA: Pomona College

Howard, P.H. 1990. *Handbook of Fate and Exposure Data for Organic Chemicals.* Chelsea, Michigan: Lewis Publishers.

Michigan Department of Environmental Quality, 2005, Gelman Sciences Inc. Site Fact Sheet, Scio Township, Washtenaw County, Michigan.

Pennsylvania Department of Environmental Protection, 1998, Public Water Supply Manual Part II, Community System Design Standards, September 1, 1998.

Systems Design Engineering, Inc., 2004, Water Distribution System Analysis, Borough of Bally, Berks County Pennsylvania, July 2004.

Santa Clara Valley Water District, 2001, Solvent Stabilizers White Paper, June 14, 2001.

U.S. Department of Health and human Services 2005, Health Consultation, 1,4-dioxane in Private Drinking Water, Mohonk Road Industrial Plant, Hamlet of High Falls, ulster County New York, June 22, 2005.

U.S. Environmental Protection Agency, 2004a, Community Update Fact Sheet, Durham Meadows Superfund Site, 1,4-Dioxane. Durham, Connecticut, March 2004,

U.S. Environmental Protection Agency, 2004b, 1,4-Dioxane Fact Sheet: Support Document. Office of Pollution Prevention and Toxics, U.S.EPA, Washington DC, March 2004.

U.S. Environmental Protection Agency, 1999, Integrated Risk Information System (IRIS) on 1,4-Dioxane. National Center for Environmental Assessment, Office of Research and Development, Washington, DC. 1999.

U.S. Environmental Protection Agency. February 1995, "OPPT Chemical Fact Sheets 1, 4-Dioxane Fact Sheet:" Pollution Prevention and Toxics, EPA 749-F-95-010a.

U.S. Environmental Protection Agency. 1991, Explanation of Significant Differences, Bally Groundwater Contamination Superfund Site, Bally Borough, berks County, Pennsylvania.

U.S. Environmental Protection Agency, 1989, Record of Decision Bally Groundwater Contamination Superfund Site, Bally Borough, berks County, Pennsylvania, May 1989.

U.S. Environmental Protection Agency, 1988a. Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA. Office of Emergency and Remedial Response, EPA/540/G-89/004, OSWER Directive 9355.3-01. October 1988.

U.S. Environmental Protection Agency, (EPIC), 1992, Unpublished, Fracture trace Analysis Berks County Study Area Berks County, Pennsylvania, December 1992.

U.S. Environmental Protection Agency, (EPIC). Unpublished, Site Analysis, Bally Case And Cooler, Bally, Pennsylvania.

REMCOR, May 1989, Draft Feasibility Study Report Bally Engineered Structures Site, Bally Pennsylvania.

Appendix A

Existing Site ARARS for VOCs

ARCADIS

Table 3. 1,4-Dioxane Treatment Technology Comparison, Bally Groundwater Contamination Site, Bally, Pennsylvania

Technology	Surface Water Discharge	Municipal Water Supply	Retained	Drawback
Granular Activated Carbon	Not suitable	Not suitable	NO	Poor adsorption characteristics (0.5-1.0 miligram of 1,4-dioxane per gram of carbon at 500 ppb)
Ozone-Catalyzed Hydrogen Peroxide	Technically suitable, likely more costly than direct ozonation	Technically suitable; likely more costly than direct ozonation	Yes	Hydrogen peroxide handling, additional operation cost
Direct Ozonation	Technically suitable, may be cost-effective	Technically suitable, may be cost effective	Yes	Reaction time is longer than Ozone/Hydrogen Peroxide method
Titanium Dioxide Photo-Catalytic Oxidation	Technically suitable, may be cost-effective	Not suitable	No	Lack of prior applications to municipal water supply systems, catalyst recovery unit for TiO2 slurry recapture may not be suitable for water supply applications
UV/Hydrogen Peroxide Oxidation	Technically suitable, may be cost-effective	Technically suitable, may be cost-effective	Yes	Hydrogen peroxide handling, additional operation cost
Phyto Remediation	Not feasible for pump & treat use	Not feasible for pump & treat use	No	Requires large amount of space, no enough treatment efficiency
Ultrasonic System	Potential technology, but still in the development phase	Not suitable for municipal water supply until it's out of the development phase	No	Cost and oxidation efficiency are questionable
"Negative Growth" Bio Reactors	Technically suitable The capital cost may be noticeably lower	Not suitable	No	The operating cost will be high, and beyond the ability of Bally municipal workers

ARCADIS

Table 5. Cost Estimate for Alternative-2: Municipal Well No. 3 Treatment, Bally Groundwater Contamination Superfund Site, Bally, Pennsylvania.

	Quantity	Unit	Cost Per Unit	Total
Treatment System Design, Permitting and Installation				
Treatment System Evaluation and Bench-Scale Testing	1	LS	$30,435	$30,435
Treatment System Pilot Test and Report	1	LS	$69,565	$69,565
Treatment System Design and Permitting	1	LS	$165,217	$165,217
Building, Treatment Units, Tanks, Electrical Service, Controls				
Mobilization	1	LS	$ 13,043	$ 13,043
Building				
Site preparation/strip topsoil	1	LS	$ 13,043	$ 13,043
Extend gravel driveway	1	LS	$ 3,478	$ 3,478
Excavation for concrete slab foundation	1	LS	$ 6,522	$ 6,522
Stone subbase for concrete slab foundation (6")	14	CY	$ 30	$ 428
Cast-in-place conc. slab foundation (19'x40'x8", 4000 psi, WWF reinf)	19	CY	$ 870	$ 16,522
Sonotube piers or grade beams under slab foundation	1	LS	$ 6,522	$ 6,522
Pre-engineered metal building (18'Wx38'Lx10'H)	684	SF	$ 30	$ 20,817
Building insulation	1	LS	$ 6,957	$ 6,957
Roll-up door	1	EA	$ 2,174	$ 2,174
Man door	1	EA	$ 1,304	$ 1,304
Tank (Chemical Storage)				
Cast-in-place conc slab for tank (10'x10'x8"), incl excav and piers	3	CY	$ 1,304	$ 3,913
Reagent tank (incl. in UV System Equipment price)	0	EA	$ 4,348	$ -
Insulation for tank	1	LS	$ 870	$ 870
Piping for tank	1	LS	$ 2,609	$ 2,609
Pump/mixer/float switches for tank (incl. in UV System Equipment price)	0	LS	$ 3,478	$ -
Electrical Construction				
New electrical service to building (20 kW, 3 phase)	1	LS	$ 21,739	$ 21,739
Electric heaters within building	1	LS	$ 2,609	$ 2,609
Other elec. constr. w/in bldg (lights, control wiring, etc.)	1	LS	$ 2,609	$ 2,609
Controls				
PLC/controls for UV system	1	LS	$ 3,478	$ 3,478
Re-program exist. PLC to connect UV system	1	LS	$ 4,348	$ 4,348
UV System Equipment				
Pilot Treatment System	4	Month	$ 17,391	$ 69,565
Permanent Treatment System	2	LS	$ 169,472	$ 338,944
Chlorination system modifications	1	LS	$ 13,043	$ 13,043
Other Construction				
Piping mods. w/in existing treatment plant (incl. connection to UV system)	1	LS	$ 4,592	$ 4,592
			Treatment System Cost Subtotal:	$824,300
			Contingency:	$123,600
			Treatment System Cost Total:	$947,900

	Quantity	Unit	Cost Per Unit	Total
Annual O&M of Modified Pump and Treat System				
System O&M (physical repairs/maint., electrical power, etc.) - existing system	1	LS	$29,165	$29,200
System Influent & Effluent Analyses and Data Review, DMRs - existing system	1	LS	$21,217	$21,200
Additional treatment system influent & effluent analyses (lab costs)	1	LS	$15,652	$15,700
Additional treatment system electrical cost due to UV-Ox	1	LS	$34,783	$34,800
Additional Operator Labor (1/2 time) labor and expenses/mileage	1	LS	$84,000	$84,000
Lamp replacement	1	LS	$14,783	$14,800
Hydrogen peroxide (5 ppm, $4.50/gal)	1	LS	$15,652	$15,700
			Annual O&M Cost Subtotal:	$215,400
			Contingency:	$32,300
			Annual O&M Cost Total:	$247,700
			Present Value for Alternative 2 2006 through 2025	$4,373,000

Notes:

All costs are based on an accuracy of +50/-30% (USEPA 2000)

30-yr Discount Rate of 3.4% based on the 5-yr (2001-2005) average of the Real Treasury Discount Rate (OMB 2005) calculations based on beginning 30-yr period in 1995

NA = Not Applicable

O&M = Operation and Maintenance

OMB = Office of Management and Budget

USEPA = United States Environmental Protection Agency

ARCADIS

Table 7 Applicable Relevant and Appropriate and To-Be-Considered Requirements for 1,4-Dioxane[1] in Bally Groundwater Contamination Site, Bally, Pennsylvania

ARAR or TBC	Location/Medium	Citation	Description/Requirement	Classification	Applicability to Selected Remedy
ARAR	Floodplains	40 CFR 6.302(b) Executive Order No. 11988	Avoid, to the extent possible, or minimize long and short term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct or indirect support of floodplain development if a practicable alternative exists Evaluate potential effects of actions that may be taken in floodplains and ensure that planning and budgeting reflect consideration of flood hazards and floodplain management.	Applicable to activities conducted within a 100-year floodplain	Portions of the proposed system will be located within the delineated 100-year floodplain zones. Generally, most construction activities during system implementation will be located at elevations above this delineation, and will not adversely impact these zones Operation and maintenance of the treatment system will be conducted to prevent any washout of waste during 100-year flood events
		40 CFR 6 Appendix A	Provide leadership and take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health, and welfare, and to restore and preserve the natural and beneficial values served by floodplains		
		40 CFR 264 18(b)	Design, construct, operate, and maintain facility in manner that prevents washout of any hazardous waste by a 100-year flood		
ARAR	Wetlands	40 CFR 6 302(a) 40 CFR 6 Appendix A Executive Order No 11990 40 CFR 230 3(t)	Avoid, to the extent possible, or minimize long and short term adverse impacts associated with the destruction, loss, or modification of wetlands and to avoid direct or indirect support of new construction in wetlands if a practicable alternative exists Provide leadership and take action to minimize destruction, loss, or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands	Relevant and appropriate to wetland areas	Wetland areas have been identified on and in the vicinity of the BES site. Precautions have and will be taken to ensure that wetlands are not impacted during implementation of the proposed treatment system.
ARAR	Sensitive Ecosystems Fish and Wildlife Resources	40 CFR 6 302(g) Fish and Wildlife Coordination Act (16 USC 661 et seq)	Take action to protect fish and wildlife resources, which may be affected by actions that will result in the control or structural modification of any natural stream or body of water for any purpose. Mitigate, prevent, and compensate for project-related losses of wildlife resources and enhance these resources	Not applicable to activities conducted	Although the existing wetland areas provide potential habitat for protected species (bog turtle), Phase I and II surveys concluded that these species were not present in areas that will be disturbed during construction associated with proposed activities
TBC	Surface Water	NPDES Permit for BES Site Permit # PA 0055123	Operate and maintain the water treatment system within compliance of the constituent concentrations specified in the permit, prior to discharge at the outfall in West Perkiomen Creek	Relevant and appropriate to activities conducted.	Interim monitoring activities at the dicharge outfall will continue until to demonstrate compliance with DEP requirements
TBC	Drinking Water	Administrative Order on Consent (AOC) for BES site # SDWA-03-2003-0301	Design, construct, operate, and maintain facility in manner that provides drinking water with 1,4-dioxane concentrations below the established AOC concentration Take action until establishment of said facility to provide an alternative drinking water supply, thereby preventing short term adverse impacts associated with the consumption of 1 4-dioxane impacted drinking water	Relevant and appropriate to activities conducted	The current AOC governs the evaluation of the selected remedy and establishes provisions for treatment of the drinking water supply

Notes

1 1,4 Dioxane CASRN # 123-91-1
ARAR Applicable or Relevant and Appropriate Requirements
TBC To Be Considered
USC United States Code
CFR Code of Federal Regulations

"Bedard, Michael" <Michael.Bedard@arcadis-us.com>

01/22/2007 12:44 PM

To Mitch Cron/R3/USEPA/US@EPA

cc aeffiong@state.pa.us, "DeMars, Steven" <sdemars@state.pa.us>, Kathy Davies/R3/USEPA/US@EPA, Jennifer

bcc

Subject RE: Bally FFS

History: This message has been replied to.

Mitch,

Sunbeam has received your Jan 16, 2007 email regarding Sunbeam's Jan 2007 response to EPA's comments on the Focused Feasibility Study (FFS) for the Bally Groundwater Contamination Site. As Chris Ann Gahagan indicated to you in her telephone conversation of Thursday January 18, 2007, Sunbeam is concerned about the substance of several of your requests, as well as the tone of your latest comments. We would also note that some of the information you requested has already been provided to you. Set forth below, as requested in your email, is an approximate schedule for addressing your latest comments:

Comments 16, 19 and 27: no additional response required and/or are covered under other requested responses (per your Jan 16 email)

Comments 7 A-D, 23 and 26: response by COB Monday February 5, 2007.

Comments 21 and 14G: ARCADIS has responded in part to Comment 21 and in full to Comment 14G in an email to you dated Jan 18, 2007. The remainder of Comment 21 will be addressed in conjunction with the remainder of Comment 14 (see below).

Comments 14 A-H, and revised FFS document: The schedule for response to Comments 14 A-H requires additional time. You have asked for information and raised issues that are outside the scope of the Safe Drinking Water Act Administrative Order on Consent and the approved FFS Work Plan. We are evaluating your requests and we will get back in touch with you regarding these issues by COB January 29.

-----Original Message-----
From: Cron.Mitch@epamail.epa.gov [mailto:Cron.Mitch@epamail.epa.gov]
Sent: Tuesday, January 16, 2007 2:23 PM
To: chrisannvols@aim.com; Bedard, Michael
Cc: aeffiong@state.pa.us; DeMars, Steven; Davies.Kathy@epamail.epa.gov; Hubbard.Jennifer@epamail.epa.gov; Pluta.Bruce@epamail.epa.gov; Dietz.Linda@epamail.epa.gov
Subject: Bally FFS

Chris Ann:

I've reviewed the Arcadis response to EPA comments on the FFS.

The following comments are considered to be resolved:
1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, 13, 15, 17, 18, 20, 22, 24, 25, 28, 29.

However, the following comments have to be addressed/require clarification:

7. A. Does PADEP have ARARs that pertain to wetland activities? They should be listed here.

B. Do State or Federal ARARs exist for erosion/sedimentation control during construction activities (well installations, pipeline construction, etc)? They should be listed here.

C. Arcadis indicates in the "Sensitive Ecosystems" ARAR (last column) that Phase I and Phase II surveys concluded that these species (bog turtle) were not present in areas that will be disturbed during construction associated with proposed activities. Did the areas evaluated include the proposed pipeline areas (from Longacre to Boro, and from MW#3 to WBPC? If not, why not?

D. Please include DVRBC requirements in the table, and indicate if they are ARAR or TBC.

14D. Broadly, the comment was not addressed. Please include a sub-alternative in the FFS, as requested. More specific comments:

A. Arcadis states, "The reasons that these treatment methods were not retained for further analysis for drinking water treatment are presented in Sections 3.1.1 and 3.1.3".

i. Ozone-Catalyzed Hydrogen Peroxide (O3/H3O2) Oxidation was ruled out because of additional logistics and operational costs. Please provide details on each of these HI-POX related issues; ie what additional logistics (be specific), what are the operational costs (Table 5 is a good example of appropriate level of detail)?

ii. Titanium Dioxide (TiO2) Photocatalytic Oxidation was ruled out because: 1) Arcadis considers this to be a relatively new technology and standardized operating procedures have not been thoroughly established for a municipal setting, and 2) the catalyst media used in the treatment process must be recaptured, recycled, and then replaced following treatment. Comment #14 was not addressed at a municipal water setting (the comment pertains to the use of the AOP to reduce 1,4-dioxane to the NDPES permit effluent limitations at the current discharge location). Is the catalyst recapture/recycle/replace requirement a largely automated function?

B. Arcadis states, "Water discharged to the present surface water discharge location would need to be treated to 3ppb or less". Is this true? The NPDES requirement is not 3 ppb; it is 5 ppb (average monthly), and 10 ppb (max daily).

C. Most importantly, the selection of Superfund remedies is an EPA function based on CERCLA and the NCP. Evaluations of remedial alternatives in accordance with the nine evaluation criteria, and selection of Superfund remedies is an EPA function, not a PRP function. Arcadis has failed to provide the evaluation of a sub-alternative specifically requested by EPA because, "the additional logistics and operational costs associated with these treatment methods would make them not cost effective as compared to construction and use of a pipeline for discharge to the WBPC." This is a determination that must be made by EPA (based on a review of alternatives in consideration of the nine evaluation criteria), not the PRP. EPA cannot make this determination until the requested sub-alternative is prepared and the costs are provided.

D. Please address Comment #14, and provide a schedule for the revised FFS by January 22, 2006. If the PRP is not willing to prepare the information requested in Comment #14, the matter will be referred to EPA ORC.

14E. The Arcadis response does not seem to make sense in the context of the response-to-comments letter and revised FFS, but no response is necc.

14F. EPA has not identified a case or reference where Titanium Dioxide (TiO2) Photocatalytic Oxidation implementation was assoc. with residual (bromate, formaldehyde) generation. Please provide additional information re: Arcadis' knowledge of residuals generation associated with this technology.

14G. If Arcadis has already rec'd a written estimate from Purifics (presumably for Titanium Dioxide (TiO2) Photocatalytic Oxidation) why has it not been provided to EPA? Provide this documentation to EPA to support the FFS.

16. No additional response necc.; this is covered elsewhere.

19. See #14; please address these comments or notify EPA that the PRP will not do so by 1/22/06.

21. Arcadis response indicates that capital costs reflect two treatment units (presumably working in series) to ensure that contaminant destruction is complete and drinking water standards are met prior to discharge to public water system. For a public water system this approach (and associated costs) may be appropriate. Would such redundant AOP treatment technology be appropriate to meet NDPES standards prior to surface water discharge? If not, how would this affect AOP costs associated with EPA comment #14? Also, please provide the supporting cost documentation from the UV/Hydrogen Peroxide Oxidation vendor asap.

23. This matter is being addressed by BTAG (EPA, FWS). For now the following comment applies from above: Arcadis concludes in the "Sensitive Ecosystems" ARAR (Table 7, last column) that Phase I and Phase II surveys concluded that these species were not present in areas that will be disturbed during construction associated with proposed activities. Did the areas evaluated include the proposed pipeline areas (from Longacre to Boro, and from MW#3 to WBPC? If not, why not?

26. It would be useful here to document what the detection limit actually was (1ppb?). If the detection limit was too high, the statement may be meaningless with regard to representation of protectiveness of human health.

27. No response necc. at this time; this is covered elsewhere.

Chris Ann: I have a pending deadline to issue the proposed plan to address the 1,4-dioxane in the Bally water system. I need to hear from you not later than next Monday on your response to the FFS comments, and when EPA will have a final FFS that addresses these comments. Anticipate that an additional 60 days will not be acceptable to EPA.

Also, please respond on the TAGA for facility VI issue; I need to firm that up with the Crossley Farms RPM.

Mitch

ARCADIS

Infrastructure, environment, buildings

ARCADIS U S , Inc
6 Terry Drive
Suite 300
Newtown
Pennsylvania 18940
Tel 267 685 1800
Fax 267 685 1801
www.arcadis-us com

ENVIRONMENT

Mitch Cron
United States Environmental Protection Agency, Region III
Hazardous Site Cleanup Division (3HS22)
1650 Arch Street
Philadelphia, Pennsylvania 19103

Subject:
Response to January 16, 2007 USEPA Comments on Focused Feasibility Study, Bally Groundwater Contamination Superfund Site

Date
5 February 2007

Contact
Mike Bedard

Phone
(267) 685-1800

Email
Michael.Bedard@arcadis-us.com

Our ref
NP000597.0002.00014

Dear Mr. Cron:

On behalf of Sunbeam Products, Inc. (Sunbeam), ARCADIS U.S., Inc. (ARCADIS) provides the following responses to address United States Environmental Protection Agency (USEPA) comments on the Focused Feasibility Study (FFS) for the Bally Groundwater Contamination Superfund Site that have not been addressed in previous emails. This letter addresses the supplemental comments and questions presented in your January 16, 2007 email to Chris Ann Gahagan of EnLibra LLC and Michael Bedard of ARCADIS.

As stated in your January 16, 2007 email, Comments 1-6, 8-13, 15, 17, 18, 20, 22, 24, 25, 28 and 29 contained in USEPA's November 13, 2006 comment letter were previously addressed by ARCADIS' letter dated January 12, 2007. A portion of comment 21 and the entirety of comment 14G (supporting treatment vendor cost information related to both comments) were addressed by the information included in an email to you from ARCADIS dated January 18, 2007. Additionally, as stated in your January 16, 2007 email, Comments 14E, 16, 19, and 27 either require no further response or are covered within the responses to other comments. Note also that Comments 14A-C also required no response.

Set forth below are the responses to the outstanding comments.

Comment 7.A-D

A. Does PADEP have ARARs that pertain to wetland activities? They should be listed here.

Sunbeam response:

ARCADIS has provided an updated list of ARARs in the attached Table 7 including Pennsylvania ARARs for wetlands.

B. Do State or Federal ARARs exist for erosion/sedimentation control during construction activities (well installations, pipeline construction, etc)? They should be listed here.

Sunbeam response:

ARCADIS has provided an updated list of ARARs in the attached Table 7 including federal and state ARARs for erosion and sedimentation pollution control during construction. The Berks County Conservation District (BCCD) letters approving the Erosion and Sedimentation Control plan (ES&C), the general permit and the stream encroachment permit for the project are attached.

C. ARCADIS indicates in the "Sensitive Ecosystems" ARAR (last column) that Phase I and Phase II surveys concluded that these species (bog turtle) were not present in areas that will be disturbed during construction *associated with proposed activities. Did the areas evaluated include the* proposed pipeline areas (from Longacre to Boro, and from MW#3 to WBPC? If not, why not?

Sunbeam response:

Phase I bog turtle surveys were conducted for both the proposed discharge pipeline route from Municipal Well #3 and for the Longacre property and associated water pipeline route to Bally Borough. A follow-up Phase II survey was also conducted at the Longacre property. As part of the ongoing work for this project, ARCADIS, on behalf of Sunbeam, is in the process of confirming that the U.S. Fish and Wildlife Service and the Pennsylvania Fish and Boat Commission still concur with the results of the prior bog turtle surveys. The initial concurrence letters are attached.

D. Please include DVRBC requirements in the table, and indicate if they are ARAR or TBC.

Sunbeam response:

ARCADIS has provided an updated list of ARARs in the attached Table 7 including various Delaware River Basin Commission (DRBC) ARARs and TBCs.

Comment 14 D:

Broadly, the comment was not addressed. Please include a sub-alternative in the FFS, as requested. More specific comments:

A. ARCADIS states, "The reasons that these treatment methods were not retained for further analysis for drinking water treatment are presented in Sections 3.1.1 and 3.1.3".

i. Ozone-Catalyzed Hydrogen Peroxide (O3/H3O2) Oxidation was ruled out because of additional logistics and operational costs. Please provide details on each of these HI-POX related issues; ie what additional logistics (be specific), what are the operational costs (Table 5 is a good example of appropriate level of detail)?

ii. Titanium Dioxide (TiO2) Photocatalytic Oxidation was ruled out because: 1) Arcadis considers this to be a relatively new technology and standardized operating procedures have not been thoroughly established for a municipal setting, and 2) the catalyst media used in the treatment process must be recaptured, recycled, and then replaced following treatment. Comment #14 was not addressed at a municipal water setting (the comment pertains to the use of the AOP to reduce 1,4-dioxane to the NDPES permit effluent limitations at the current discharge location). Is the catalyst recapture/recycle/replace requirement a largely automated function?

B. Arcadis states, "Water discharged to the present surface water discharge location would need to be treated to 3ppb or less". Is this true? The NPDES requirement is not 3 ppb; it is 5 ppb (average monthly), and 10 ppb (max daily).

C. Most importantly, the selection of Superfund remedies is an EPA function based on CERCLA and the NCP. Evaluations of remedial alternatives in accordance with the nine evaluation criteria, and selection of Superfund remedies is an EPA function, not a PRP function.

Arcadis has failed to provide the evaluation of a sub-alternative specifically requested by EPA because, "the additional logistics and operational costs associated with these treatment methods would make them not cost effective as compared to construction and use of a pipeline for discharge to the WBPC." This is a determination that must be made by EPA (based on a review of alternatives in consideration of the nine evaluation criteria), not the PRP. EPA cannot make this determination until the requested sub-alternative is prepared and the costs are provided.

D. Please address Comment #14, and provide a schedule for the revised FFS by January 22, 2006. If the PRP is not willing to prepare the information requested in Comment #14, the matter will be referred to EPA ORC.

Sunbeam response:

14A. This comment states that Comment 14 was not addressed at a municipal water setting, but instead to the use of the Advance Oxidation Process (AOP) to reduce 1,4 dioxane to the NPDES permit effluent limitations at the current discharge locations. ARCADIS did not evaluate the use of the AOP to reduce effluent concentrations for surface water discharge purposes. Such evaluation was beyond the scope of the September 30, 2003 Safe Drinking Water Act Administrative Order on Consent, (AOC) and the approved Work Plan prepared pursuant to the AOC. In accordance with the AOC, the FFS was prepared to "*identify comprehensive alternatives to reduce the 1,4-dioxane concentrations identified in the Bally Borough PWS to achieve one of the following alternatives: (i) 3.0 ppb; or (ii) if 3.0 ppb is not practicable and feasible and reasonable achievable on a consistent basis, some other concentration approved by EPA in consultation with the Commonwealth of Pennsylvania, taking into consideration, among other things cost and limitations to treatment technology to consistently and effectively achieve this concentration as applied to the field at this site.*" The AOC specified that the FFS "*shall include, at a minimum, a thorough exploration of the following options:*

A. *New Well Option*

Installation and utilization of a new municipal well that meets the standards of the federal and state SDWA and their implementing regulations to provide a source of drinking water for the Borough of Bally that does not exhibit 1,4-dioxane concentrations is excess of 3.0 ppb.

B. *Municipal Well Treatment Option*

Treatment of 1,4-dioxane at Municipal Well #3 to achieve one of the following alternatives: (i) 3.0 ppb; or (ii) if 3.0 ppb is not practicable and feasible and reasonable achievable on a consistent basis, some other concentration approved by EPA in consultation with the Commonwealth of Pennsylvania, taking into consideration, among other things cost and limitations to treatment technology to consistently and effectively achieve this concentration as applied to the field at this site."

ARCADIS conducted a preliminary review of the available technologies to determine which technologies were best suited for further evaluation. This information was provided to the USEPA in the letter dated August 20, 2003 "Evaluation of 1,4-Dioxane Treatment for the Bally drinking Water Supply System". For your convenience, we have attached this letter. ARCADIS then prepared a Work Plan for the preparation of the FFS as required by the AOC. The final Work Plan, dated May 20, 2004 was approved by the EPA in an email dated May 27, 2004. The approved FFS Work Plan is also attached.

The Work Plan specified that Sunbeam would evaluate treatment of water discharged to the Bally Public Water Supply (PWS) to remove 1,4-dioxane by focusing on AOPs such as "gaseous ozonation and ultra-violet light/hydrogen peroxide treatment". These were the technologies that passed the preliminary screening for the Bally Site taking into account several factors, such as potential applicability to a PWS and ability to handle a relatively high flow rate (on the order of 200 gallons per minute or more). Based upon these criteria the only AOP technologies determined to be suitable were gaseous ozonation and ultra-violet light/hydrogen peroxide treatment. Other technologies were found to be not suitable for use in a public water supply setting and were therefore not evaluated further in the 2003 1,4-dioxane treatment evaluation, nor in the FFS.

14B. ARCADIS will correct the FFS by changing the "3 ppb" that appears in the text to "5 ppb" to reflect the correct allowable monthly average 1,4-dioxane concentration allowed for discharge to the West Branch Perkiomen Creek (West Branch). With respect to the question above regarding catalyst capture/recycle, the answer is "yes"; this is largely an automated function. The other items in this comment are addressed as follows.

14C. Sunbeam agrees that the selection of Superfund remedies is an EPA function.

However, your November 13, 2006 comment letter and January 16, 2007 email, requested information beyond the scope of the AOC and the approved Work plan related to the treatment of Bally PWS water to remove 1,4-dioxane for water supply, but instead asked for information regarding the treatment of 1,4-dioxane in water discharged to surface water. The AOC specified that the remedies to be evaluated were for removal of 1,4-dioxane from the Bally PWS. Treatment of 1,4-dioxane in water extracted from MUN-3 prior to discharge to surface water is clearly outside the scope and intent of the AOC and FFS Work Plan. Treatment of the discharge to the unnamed tributary adjacent to Municipal Well No. 3 was not conducted because it was not required by the AOC and the Work Plan approved by EPA.

After discovery of 1,4-dioxane in the Bally PWS, it was fairly quickly established that providing a new water supply well to Bally would be the most effective option. Therefore, the PADEP was consulted and a permit was obtained to discharge the Municipal Well # 3 (MUN-3) water to the West Branch. Thus, the PADEP has permitted the discharge of the present MUN-3 treatment system effluent by issuing a National Pollutant Discharge Elimination System (NPDES) permit for MUN-3 effluent treated by an existing air stripper system. The permitted discharge for the West Branch is limited to a monthly average 1,4-dioxane concentration of 112 parts per billion (ppb).

Comment 14F:

14F. EPA has not identified a case or reference where Titanium Dioxide (TiO2) Photocatalytic Oxidation implementation was assoc. with residual (bromate, *formaldehyde) generation. Please provide additional information re: Arcadis'* knowledge of residuals generation associated with this technology.

Sunbeam response: As stated in ARCADIS' letter dated January 12, 2007, residual formation is possible for any of the AOP treatment methods. ARCADIS did not conduct an extensive survey of users of the TiO2 Photocatalytic Oxidation system offered by Purifics because that was not necessary for water supply evaluation purposes (potential for residual formation is already known, and TiO2 Photocatalytic Oxidation was screened out for PWS supply), and because evaluation of AOP treatment at Municipal Well No. 3 for surface water treatment purposes was not within the scope of the AOC or Work Plan.

Comment 14G:

If Arcadis has already rec'd a written estimate from Purifics (presumably for Titanium Dioxide (TiO2) Photocatalytic Oxidation) why has it not been provided to EPA? Provide this documentation to EPA to support the FFS.

Sunbeam response: As noted above, ARCADIS provided this information to USEPA in an email dated January 18, 2007.

Comment 21:

Arcadis response indicates that capital costs reflect two treatment units (presumably working in series) to ensure that contaminant destruction is complete and drinking water standards are met prior to discharge to public water system. For a public water system this approach (and associated costs) may be appropriate. Would such redundant AOP treatment technology be appropriate to meet NDPES standards prior to surface water discharge? If not, how would this affect AOP costs associated with EPA comment #14? Also, please provide the supporting cost documentation from the UV/Hydrogen Peroxide Oxidation vendor asap.

Sunbeam response: In order to ensure complete and consistent treatment to below the required maximum 1,4-dioxane concentration of 5 ppb (average monthly value) for surface water discharge to the unnamed tributary adjacent to Municipal Well No. 3, two AOP treatment units (in series) would be necessary. In accordance with the AOC and approved Work Plan, ARCADIS did not evaluate treatment of 1,4-dioxane for surface water discharge purposes. As stated above, supporting UV/Hydrogen Peroxide Oxidation vendor cost information was provided to USEPA in an email from ARCADIS dated January 18, 2007.

Comment 23.

This matter is being addressed by BTAG (EPA, FWS). For now the following comment applies from above: Arcadis concludes in the "Sensitive Ecosystems" ARAR (Table 7, last column) that Phase I and Phase II surveys concluded that these species were not present in areas that will be disturbed during construction associated with proposed activities. Did the areas evaluated include the proposed pipeline areas (from Longacre to Boro, and from MW#3 to WBPC? If not, why not?

Sunbeam response:

As described in the response to comment 7C, Phase I bog turtle surveys were conducted for both the proposed discharge pipeline route from Municipal Well #3 and for the Longacre property and associated water pipeline route to Bally Borough. A follow-up Phase II survey was also conducted at the Longacre property. Information regarding the wetland and bog turtle surveys conducted north of the Borough (Longacre property) was previously provided to USEPA in the ARCADIS March 2006 report entitled: "Detailed Hydrogeologic Water Resources Investigation Report" (WRI). Both the U.S. Fish and Wildlife Service and the Pennsylvania Fish and Boat Commission issued concurrence letters to these surveys which were provided as part of the WRI (see attached). The Phase 1 wetland delineation report, dated December 2004, was prepared by Amy S. Greene Environmental Consultants Inc. for the discharge pipeline. As part of the ongoing work for this project, ARCADIS, on behalf of Sunbeam, is in the process of confirming that the U.S. Fish and Wildlife Service and the Pennsylvania Fish and Boat Commission still concur with the results of the prior bog turtle surveys.

Comment 26:

It would be useful here to document what the detection limit actually was (1ppb?). If the detection limit was too high, the statement may be meaningless with regard to representation of protectiveness of human health.

Sunbeam response: 1,4-Dioxane was not detected in groundwater samples collected at the proposed new well site. The detection limit was 3.0 for the samples collected in June 2005, 2.8 for the samples collected from PW-01 on December 13, 2005 and 2.9 for the samples collected from well 87-7I on December 5 and 14, 2005.

ARCADIS believes that the responses above address the remaining issues that you identified in your email dated January 16, 2007. Upon receiving your concurrence on these issue ARCADIS will begin preparing the final version of the FFS. Should you have any further questions or concerns please feel free to contact us.

We trust that these responses sufficiently address your comments. If you require additional information, please do not hesitate to contact Sunbeam or ARCADIS.

Sincerely,

ARCADIS U.S., Inc.

Christopher T. Sharpe
Project Geologist

Michael F. Bedard, P.E.
Project Manager

Attachment:
Table 7 (revised)
Erosion and Sedimentation Control Plan Approval Letter
General Permit Approval Letter
Stream Encroachment Permit Approval Letter
Evaluation of 1,4-Dioxane Treatment for the Bally Drinking Water Supply System
FFS Work Plan

Copies:
R. Reinhart, USEPA
S. Werner, PADEP
A. Effiong, PADEP
T. Hemerka, Bally Borough
L. Borland, Jarden Corp.
C. A. Gahagan, EnLibra LLC
R. Mowrey, Jarden Corp.

ARCADIS

Table 7. Applicable Relevant and Appropriate and To-Be-Considered Requirements for 1,4-Dioxane[1] in Bally Groundwater
Bally Groundwater Contamination Site, Bally, Pennsylvania.

ARAR or TBC	Location/Medium	Citation	Description/Requirement	Classification	Applicability to Selected Remedy
ARAR	Floodplains	40 CFR 6.302(b) Executive Order No. 11988	Avoid, to the extent possible, or minimize long and short term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct or indirect support of floodplain development if a practicable alternative exists. Evaluate potential effects of actions that may be taken in floodplains and ensure that planning and budgeting reflect consideration of flood hazards and floodplain management.	Applicable to activities conducted within a 100-year floodplain.	Portions of the proposed system will be located within the delineated 100-year floodplain zones. Generally, most construction activities during system implementation will be located at elevations above this delineation, and will not adversely impact these zones. Operation and maintenance of the treatment system will be conducted to prevent any washout of waste during 100-year flood events. Stream encroachments and utility line crossings will be reviewed and approved by the Conservation District through the Pennsylvania General Permit process prior to construction
		40 CFR 6 Appendix A	Provide leadership and take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health, and welfare, and to restore and preserve the natural and beneficial values served by floodplains.		
		40 CFR 264.18(b)	Design, construct, operate, and maintain facility in manner that prevents washout of any hazardous waste by a 100-year flood.		
		PA Code Title 25 Chapters 105 and 106	Plan, design, construct, maintain and monitor to prevent unreasonable interference with water flow, protect natural resources and water quality, and protect health, safety, welfare and property from flooding.		
ARAR	Wetlands	40 CFR 6.302(a) 40 CFR 6 Appendix A Executive Order No. 11990 40 CFR 230.3(t)	Avoid, to the extent possible, or minimize long and short term adverse impacts associated with the destruction, loss, or modification of wetlands and to avoid direct or indirect support of new construction in wetlands if a practicable alternative exists. Provide leadership and take action to minimize destruction, loss, or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands.	Relevant and appropriate to wetland areas.	Wetland areas have been identified on and in the vicinity of the BES site. Precautions have and will be taken to ensure that wetlands are not impacted during implementation of the proposed treatment system. Stream encroachments and utility line crossings will be reviewed and approved by the Conservation District through the Pennsylvania General Permit process prior to construction
		PA Code Title 25 Chapter 105	Plan, design, construct, maintain and monitor to protect natural resources, environmental rights and values and conserve and protect the water quality and natural regime. Avoid, to the extent possible, or minimize long and short term adverse impacts associated with the destruction, loss, or modification of wetlands and to avoid direct or indirect support of new construction in wetlands if a practicable alternative exists		
ARAR	Sensitive Ecosystems: Fish and Wildlife Resources	40 CFR 6 302(g) Fish and Wildlife Coordination Act (16 USC 661 et. seq)	Take action to protect fish and wildlife resources, which may be affected by actions that will result in the control or structural modification of any natural stream or body of water for any purpose. Mitigate, prevent, and compensate for project-related losses of wildlife resources and enhance these resources	Not applicable to activities conducted	Although the existing wetland areas provide potential habitat for protected species (bog turtle), Phase I and II surveys concluded that these species were not present in areas that will be disturbed during construction associated with proposed activities.

Notes:

[1] 1,4-Dioxane CASRN # 123-91-1

ARAR Applicable or Relevant and Appropriate Requirements
TBC To Be Considered
USC United States Code
CFR Code of Federal Regulations
DRB Delaware River Basin Commission

ARCADIS

Table 7. Applicable Relevant and Appropriate and To-Be-Considered Requirements for 1,4-Dioxane[1] in Bally Groundwater
Bally Groundwater Contamination Site, Bally, Pennsylvania

ARAR or TBC	Location/Medium	Citation	Description/Requirement	Classification	Applicability to Selected Remedy
ARAR	Groundwater	DRBC Water Code Article 2.20.7	Take action to register any well system withdrawing an average of at least 10,000 gallons/day for any 30-day period within the Delaware River Basin	Relevant and appropriate to activities conducted.	Well records have already been provided to PADEP, and any supply well will be registered once permanent pumping equipment is installed.
ARAR	Groundwater, Surface Water and Drinking Water	DRBC Water Code Articles 2 50 3B.1 and 3.20.6	Take action to perform annual reporting meeting the requirements for public water supplies and meet applicable requirements for DRBC Zone 1E.	Relevant and appropriate to activities conducted.	The Borough of Bally will provide the DRBC with annual reports, including Source Data and Service Area Data, and, as appropriate, will adhere to the acceptable conditions for Water Uses to be Protected, Stream Quality Objectives, and Effluent Quality Requirements.
ARAR	Land and Surface Water	PA Code Title 25 Chapters 92 and 102 40 CFR 122.26(c)	Take action to implement and maintain erosion and sediment control measures for any earthmoving activities, and develop and implement an approved erosion and sediment control plan for any land disturbance over 5,000 square feet and obtain a NPDES permit for disturbances over 1 acre	Relevant and appropriate to construction activities.	Construction activities for remedy implementation will utilize and maintain erosion and sediment control best management practices (BMPs), and will have approved plans and NPDES permits as needed.
TBC	Surface Water	NPDES Permit for BES Site Permit # PA 0055123	Operate and maintain the water treatment system within compliance of the constituent concentrations specified in the permit, prior to discharge at the outfall in West Perkiomen Creek	Relevant and appropriate to activities conducted.	Interim monitoring activities at the discharge outfall will continue to demonstrate compliance with DEP requirements.
TBC	Groundwater and Drinking Water	DRBC Water Code Article 2.1.2C, 2.20.4, 2.50.1, 2 50.2A	Take action to limit groundwater withdrawals to the maximum draft of all withdrawals from an aquifer that can be reliably sustained without impacting ground water levels, water quality or perennial streams. Measurements of groundwater withdrawals and public water usage at individual premises shall be implemented. A water conservation plan shall be required for a new groundwater withdrawal	Relevant and appropriate to activities conducted	The effects of pumping have been thoroughly evaluated as documented in the ARCADIS March 2006 Detailed Hydrogeologic Water Resources Investigation Report. The Borough of Bally has a water conservation plan and ordinance requiring metering at premises connected to public water
TBC	Drinking Water	Administrative Order on Consent (AOC) for BES site # SDWA-03-2003-0301	Design, construct, operate, and maintain facility in manner that provides drinking water with 1,4-dioxane concentrations below the established AOC concentration. Take action until establishment of said facility to provide an alternative drinking water supply, thereby preventing short term adverse impacts associated with the consumption of 1,4-dioxane impacted drinking water.	Relevant and appropriate to activities conducted.	The current AOC governs the evaluation of the selected remedy and establishes provisions for treatment of the drinking water supply.

Notes

[1] 1,4-Dioxane CASRN # 123-91-1
ARAR Applicable or Relevant and Appropriate Requirements
TBC To Be Considered
USC United States Code
CFR Code of Federal Regulations
DRB Delaware River Basin Commission

BERKS COUNTY CONSERVATION DISTRICT
1238 County Welfare Road • Suite 200
Leesport, PA 19533-0520
610-372-4657 ext. 201 • Fax 610-478-7058
www.co.berks.pa.us/conservation

July 18, 2006

Sandra Moser
Manager
Washington Township
Box 52, 120 Barto Road
Barto, PA, 19504

Subject: Bally Discharge Pipeline
Tax Parcel ID: n/a
Washington Township / Bally Borough, Berks County, PA

Dear Manager Moser,

The Erosion and Sediment Control (E&SC) plan, which was designed for the above named project has been reviewed for adequacy. The project, originally 0.87 acres, with a total disturbance of 0.87 acres, is located along Old Route 100 in Washington Township and along various side streets of the Borough of Bally, Berks County.

The E&SC plan is adequate for erosion and sediment control during normal weather conditions.

The District, in reviewing this plan, does not accept responsibility for project controls and does not authorize any land use changes. Before any construction or earthmoving activities may begin, any pertinent local, state and federal permits must be secured from the agency having specific permitting authority.

This letter is to be included in the final E&SC plan as provided to the earthmoving contractor. The contractor should notify the District three (3) days prior to any earthmoving activities.

A copy of the E&SC plan must be available at the site of the earthmoving activity.

If the earthmoving activity described within this plan is not initiated within two years from the date of this letter, the review will expire and the plan will be considered inadequate. The plan will then have to be resubmitted to the Conservation District and reviewed again for adequacy.

If further assistance is required, please do not hesitate to contact the Berks County Conservation District.

Sincerely,

Kelly M. Grube
E&SPC Specialist
Berks County Conservation District

KMG/kmg

Cc: Michael Bedard / Arcadis, Inc.
Chris Atkins
Bally Borough
File

BERKS COUNTY CONSERVATION DISTRICT
1238 County Welfare Road • Suite 200
Leesport, PA 19533-0520
610-372-4657 ext. 201 • Fax 610-478-7058
www.co.berks.pa.us/conservation

July 18, 2006

Chris Atkins
Sunbeam Products, Inc.
2381 Executive Center Drive
Boca Raton, FL 33431

Subject: GP 04-06-06-1-006
Bally Discharge Pipeline
Washington Township / Bally Borough, Berks County, PA

Dear Mr. Atkins,

The Berks County Conservation District received your notification to **install a water line with a discharge connection to the West Branch of the Perkiomen Creek**, in Bally Borough and Washington Township, Berks County, in accordance with the Department of Environmental Protection, Bureau of Dams, Waterways and Wetlands, BDWW-GP-4, Intake and Outfall Structures.

Acknowledgement of this General Permit is based on the information provided by you to this office. An on-site inspection has not been performed, therefore you are responsible for assuring that any work undertaken in the areas not authorized by this permit (Item 6) shall be in violation of the Dam Safety and Encroachments Act, as amended, and the rules and regulations as adopted thereto by the Environmental Quality Board, and shall be subject to citing under the provisions thereof.

This will acknowledge receipt of your notification (copy enclosed) and registers your use of a General Permit issued by the Department of Environmental Protection (DEP). You are responsible for assuring the work is done in accordance with the drawings and conditions contained in the General Permit. Before performing any work, you are required to secure all other approvals that may be necessary under other federal, state, or local regulations and notify the PA Fish and Boat Commission (717-626-0228) in accordance with Item 19 of the General Permit. The BCCD has received and reviewed an Erosion and Sediment Pollution Control Plan for adequacy for this installation.

Attached to this acknowledgement you will find your Federal Clean Water Act Section 404 authorization in the form of the Pennsylvania State Programmatic General Permit (SPGP).

Sincerely,

Kelly M. Grube
E&SPC Specialist
Berks County Conservation District

Cc: Us Army Corps of Engineers / Philadelphia District
Vincent Dick Jr. / PA Fish & Boat Commission
Michael Bedard / Arcadis Inc.
Bally Borough
Washington Township

BERKS COUNTY CONSERVATION DISTRICT
1238 County Welfare Road • Suite 200
Leesport, PA 19533-0520
610-372-4657 ext. 201 • Fax 610-478-7058
www.co.berks.pa.us/conservation

July 18, 2006

Chris Atkins
Sunbeam Products, Inc.
2381 Executive Center Drive
Boca Raton, FL 33431

Subject: GP 05-06-06-1-006
Bally Discharge Pipeline
Bally Borough and Washington Township, Berks County, PA

Dear Mr. Atkins,

The Berks County Conservation District received your notification to **install a utility crossing through an unnamed tributary to the Perkiomen Creek and wetlands in Borough of Bally Municipal Park and wetlands in the right of way of Old Route 100,** Bally Borough, Berks County, in accordance with the Department of Environmental Protection, Bureau of Dams, Waterways and Wetlands, General Permit BDWM-GP-5, Utility Line Stream Crossings

Acknowledgement of this General Permit is based on the information provided by you to this office. An on-site inspection has not been performed, therefore you are responsible for assuring that any work undertaken in the areas not authorized by this permit (Item 5) shall be in violation of the Dam Safety and Encroachments Act, as amended, and the rules and regulations as adopted thereto by the Environmental Quality Board, and shall be subject to citing under the provisions thereof.

This will acknowledge receipt of your notification (copy enclosed) and registers your use of a General Permit issued by the Department of Environmental Protection (DEP). You are responsible for assuring the work is done in accordance with the drawings and conditions contained in the General Permit. Before performing any work, you are required to secure all other approvals that may be necessary under other federal, state or local regulations and notify the PA Fish and Boat Commission (717-626-0228) in accordance with Item 19 of the General Permit. The BCCD has received and reviewed an Erosion and Sediment Pollution Control Plan for adequacy for this installation.

Attached to this acknowledgement you will find your Federal Clean Water Act Section 404 authorization in the form of the Pennsylvania State Programmatic General Permit (SPGP-2).

Sincerely,

Kelly M. Grube
E&SPC Specialist
Berks County Conservation District

Cc: Us Army Corps of Engineers / Philadelphia District
Vincent Dick / PA Fish & Boat Commission
Michael Bedard / Arcadis Inc.
Bally Borough
Washington Township

IMPORTANT DOCUMENT
TELECOPIER COVER SHEET

Date: 4/11/05 **Time:** 0945

TO: **CHRIS SHARP**

Telephone:
Fax Number: 267-685-1801

FROM:

Pennsylvania Department of
Environmental Protection
http://www..state.pa.us

JACK D. HILL
Biologist
Water Management Program

SouthCentral Region
909 Elmerton Avenue
Harrisburg, PA 17110-8200

717-705-4807
717-705-4760
jahill@state.pa.us

RE: **PNDI Results**

MESSAGE:

Total Number of Pages 2 (including this page)

PNDI Internet Database Search Results

PNDI Search Number: N171695
Search Results For hill.jack@dep.state.pa.us
Search Performed By: Jack Hill On 4/11/05 9:53:57 AM
Agency/Organization: PA Department of Environmental Protection
Phone Number: 717-705-4807
Search Parameters: Quad - 407545 - EAST GREENVILLE; Acres - 50
Project location center (Latitude): 40deg. 24min. 45sec.
Project location center (Longitude): 75deg. 35min. 0sec.
Project Type: Planning/Project Pre-Planning

Print this page using your Internet browser's print function and keep it as a record of your search.

No conflicts with ecological resources of special concern are known to exist within the specified search area.

PNDI is a site specific information system, which describes significant natural resources of Pennsylvania. This system includes data descriptive of plant and animal species of special concern, exemplary natural communities and unique geological features. PNDI is a cooperative project of the Department of Conservation and Natural Resources, The Nature Conservancy and the Western Pennsylvania Conservancy. This response represents the most up-to-date summary of the PNDI data files and is valid for 1 year. An absence of recorded information does not necessarily imply actual conditions on-site. A field site survey may reveal previously unreported populations of rare species, their critical habitats, or other unique natural resources.

Legal authority for Pennsylvania's biological resources resides with three administrative agencies. The handout entitled Pennsylvania Biological Resource Management Agencies, outlines which species groups are managed by these agencies. Feel free to contact our office if you have questions concerning this response or the PNDI system, and please refer to the PNDI Search Number at the top of this page in future correspondence concerning this project.

[redacted] New Search Using Latitude and Longitude

Pennsylvania Fish & Boat Commission

established 1866

Division of Environmental Services
Natural Diversity Section
450 Robinson Lane
Bellefonte, PA 16823-9620
(814) 359-5237 Fax: (814) 359-5175

August 23, 2005

IN REPLY REFER TO
SIR# 20252

AUG 25 2005

AMY S. GREENE ENVIRONMENTAL CONSULTANTS
SCOTT ANGUS
4 WALTER E. FORAN BLVD., SUITE 209
FLEMINGTON, NJ 08822

RE: Secondary Species Impact Review (SIR) #20252
Bog Turtle Survey
BALLY WATER SUPPLY
WASHINGTON Township, BERKS County, Pennsylvania

Dear MR. ANGUS:

The staff of the Natural Diversity Section reviewed your recent correspondence regarding the above-referenced project and its potential to adversely impact the bog turtle (*Clemmys muhlenbergii*), Pennsylvania endangered, federally listed as threatened.

As an approved bog turtle surveyor following the U.S. Fish and Wildlife Service Guidelines, you conducted a Phase 2 presence/absence survey for bog turtles, during the appropriate seasonal and climatic conditions in 2005. No bog turtles were found during the surveys. We concur with your conclusion – presently, bog turtles do not exist at these wetlands.

Provided that best management practices are employed and strict erosion and sedimentation controls are used, I do not foresee the proposed project resulting in adverse impacts to the bog turtle or any other rare or protected species under Pennsylvania Fish and Boat Commission jurisdiction. Thank you for your cooperation and attention to this matter of threatened and endangered species conservation.

Sincerely,

Christopher A. Urban, Chief
Natural Diversity Section

RTM/ma

cc: B. Dershem, USFWS
DEP-SC Region

H 3521

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Pennsylvania Field Office
315 South Allen Street, Suite 322
State College, Pennsylvania 16801-4850

September 8, 2005

Scott Angus
Amy S. Greene Environmental Consultants, Inc.
4 Walter E. Foran Boulevard, Suite 209
Flemington, NJ 08822

RE: USFWS Project #2005-2356

Dear Mr. Angus:

This responds to your letter of July 12, 2005, which provided the Fish and Wildlife Service with information regarding the proposed Borough of Bally municipal well, located in Washington Township, Berks County, Pennsylvania. The proposed project is within the range of the bog turtle (*Clemmys muhlenbergii*), a species that is federally listed as threatened. The following comments are provided pursuant to the Endangered Species Act of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.*) to ensure the protection of endangered and threatened species.

You have provided a copy of your July 12, 2005, *Phase 2 Survey Report*. According to this report, which describes the survey conducted by you on May 5, 12, 19, and 27, 2005, no bog turtles were found in project area wetlands. Therefore, based on our review of this information, we conclude that construction of this project will not affect the bog turtle.

If this project is implemented as proposed, construction will not affect any federally listed or proposed species or their habitat. This response relates only to endangered or threatened species under our jurisdiction. Consequently, this letter is not to be construed as addressing potential Service concerns under the Fish and Wildlife Coordination Act or other authorities.

To avoid potential delays in reviewing your project, please use the above-referenced USFWS project tracking number in any future correspondence regarding this project.

If you have any further questions regarding this matter, please contact Jennifer Dombroskie of my staff at 814-234-4090.

Sincerely,

David Densmore
Supervisor

ARCADIS

infrastructure, buildings, environment, communications

ARCADIS G&M, Inc
6 Terry Drive
Suite 300
Newtown
Pennsylvania 18940
Tel 267 685 1600
Fax 267 685 1601
www.arcadis-us.com

ENVIRONMENTAL

Mitch Cron
Remedial Project Manager
U.S. Environmental Protection Agency, Region III
1650 Arch Street, 3H322
Philadelphia, Pennsylvania 19103

Subject:
Evaluation of 1,4-Dioxane Treatment for the Bally Drinking Water Supply System, Bally Groundwater Contamination Site, Bally, Pennsylvania

Date
20 August 2003

Contact
Frank Lenzo

Phone
(267) 685-1800

Email
flenzo@arcadis-us.com

Our ref:
NP000568.0002

Dear Mr. Cron:

On behalf of American Household, Inc. (AHI), ARCADIS presents this update and evaluation of ex-situ treatment for 1,4-dioxane present in the Borough of Bally Public Water Supply (PWS) in the Borough of Bally, Berks County, Pennsylvania. Treatment of 1,4-dioxane in the groundwater from the present drinking water supply well for the Bally PWS (Municipal Well No. 3) is an option that is being considered along with other options, such as developing an alternate drinking water source that is of adequate capacity and satisfactory water quality. This update and evaluation focuses on the feasibility of treatment to low levels such as the 3 or 6 micrograms per liter (µg/L) for 1,4-dioxane proposed by the United States Environmental Protection Agency (USEPA) and Pennsylvania Department of Environmental Protection (PADEP) for the Bally PWS.

Background

Based on a comprehensive review of available treatment technologies, the best available technologies (BAT) for treatment of 1,4-dioxane for a PWS (such as the Bally system) are most likely gaseous ozone (ozonation) and ultra-violet light/hydrogen peroxide (UV/peroxide) treatment. Other treatment technologies and variations of advanced oxidation processes (AOPs) exist, but are less attractive for a variety of reasons, not the least of which is the lack of performance history and data for applications comparable to the Bally PWS.

Treatment Technology Testing and Vendor/Operator Survey

ARCADIS performed bench-scale testing of the ozonation and UV/peroxide technologies on water samples collected from Bally Municipal Well No. 3. These water samples were collected in March, April and June 2003, from a collection point located after the second air stripping tower but prior to the water chlorination system. The ozonation testing was performed by Michigan State University, and the UV/peroxide testing was performed by Trojan Technologies, Inc. Results of pre- and post-treatment 1,4-dioxane concentrations, as well as reaction byproduct data, are presented on the attached Tables 1 through 4.

The bench scale test results included the following:

- The ozonation process reduced the 1,4-dioxane from 60 µg/L to less than 1 µg/L after 15 minutes of contact time with a 5% ozone feed into one liter of water;
- The UV/peroxide process reduced the 1,4-dioxane concentrations from approximately 290 µg/L (sample spiked with additional 1,4-dioxane) to less than 30 µg/L after 120 minutes of contact time using a 30 watt UV lamp[1];
- The ozonation process left a by-product residual of 13 µg/L of formaldehyde and 60 µg/L of bromate after 15 minutes contact time;
- The UV/peroxide process left a by-product residual of 42 µg/L of formaldehyde and no bromate (non-spiked sample).

ARCADIS also surveyed multiple vendors, operators and regulators of systems presently used for 1,4-dioxane treatment as part of this evaluation. This survey allowed an assessment of other parties' experiences for treatment of 1,4-dioxane.

While other ozonation and UV/peroxide treatment systems that treat 1,4-dioxane are in operation, there is a limited body of data on their effectiveness, performance and practicability. This limited data does not allow for confident extrapolation of performance results to a system such as the Bally PWS. For the fourteen treatment system regulators, vendors and operators that were identified and contacted, only one instance was found where an operating treatment system discharges water directly to a PWS. However, 1,4-dioxane is not the primary contaminant of concern at this site. The influent 1,4-dioxane concentrations for that treatment system typically are less than 3 µg/L, which is far below the levels at the Bally Municipal Well No. 3.

For this same group of vendors and operators, systems with similar or higher concentrations of 1,4-dioxane as Municipal Well No. 3 did not discharge directly to a potable water system, and/or were configured in a way that would be impractical for the Bally PWS. As such, a history of consistent treatment to 3 µg/L or less for influent 1,4-dioxane concentrations and flow rates similar to those observed at Municipal Well No. 3, for a system similar to the Bally PWS, was not discovered during ARCADIS' survey.

Relevant Concerns for Potential Bally PWS Treatment System

There are several key concerns, related to the treatment of 1,4-dioxane-impacted groundwater for the Bally system, which must be considered.

---

[1] UV/peroxide samples were spiked for this test to ensure that the pre- and post-treatment 1,4-dioxane concentrations were well above Trojan's analytical detection limit of 10 µg/L. Spiking has no effect on the actual treatment assessment, as reaction rates are linear, and the kinetic rate at these relative concentrations is comparable (i.e. spiked compared to non-spiked samples).

The most important is the ability of any treatment system to reliably and consistently treat 30 to 60 µg/L of 1,4-dioxane to less than 3 µg/L, and the formation and control of reaction byproducts. The vendor/user survey and bench scale testing recently conducted do not adequately demonstrate the ability of UV/peroxide or ozonation (BAT for 1,4-dioxane) to consistently achieve levels of 1,4-dioxane below 3 µg/L. As noted in this letter, there is a lack of analogous field data and questions about the accuracy of the extrapolation of the lab data to the field in this situation.

However, maybe most importantly, reaction byproducts residuals, such as bromate and formaldehyde, can form during treatment by these technologies. Avoidance of byproduct formation would need to be guaranteed for any treatment system for Municipal Well No. 3 if this well would be used for the Bally PWS.

As indicated in the attached tables, bromate was detected in water treated by ozonation at concentrations of approximately 50 to 60 µg/L, well above the USEPA and PADEP Drinking Water MCL of 10 µg/L. A sample of UV/peroxide-treated water was also analyzed for formaldehyde as part of the bench-scale testing. Formaldehyde was detected in UV/peroxide-treated water at a concentration of 42 µg/L. Although no MCL exists for formaldehyde, similar to 1,4-dioxane, EPA has identified health concerns associated with the consumption of drinking water containing formaldehyde. For the treatment system vendors and operators contacted by ARCADIS, consistent byproducts testing for compounds such as bromate and formaldehyde generally is not conducted. As such, a definitive history of systems with a documented absence of treatment byproducts, that would be sufficient to allow extrapolation to Municipal Well No. 3 water and the Bally PWS, was not clearly evident based on ARCADIS' survey.

Development of Drinking Water Standards & BACT

As EPA is aware, the Safe Drinking Water Act ("SDWA") empowered EPA to define drinking water standards. However, EPA is required by law (1996 Amendments to the SDWA) to establish those standards through a process that involves determining whether setting a standard is appropriate and, if so, what that standard should be. Scientific and technological issues are considered including factors ranging from occurrence in the environment to health effects. The EPA must go through three steps in standard setting: 1) identify drinking water quality problems; 2) prioritize the problems; and, 3) propose and finalize a drinking water regulation. The EPA then sets a maximum contaminant level goal (MCLG), which is typically set above zero for carcinogens for which a safe dose can be determined. After the MCLG is set, EPA is then required to assess what level is feasible with available technology. Ultimately, an enforceable standard, the maximum contaminant level or "MCL" is set based on the level that is feasible utilizing BAT, or "best available technology". When developing the BAT, EPA is required to take into consideration field conditions and cost. Consideration is also given to what levels are present and whether analytical techniques are available that are consistently defensible (vinyl chloride is an excellent example of an MCL set based on available analytical tools). When analyzing the benefits, the factual basis of whether the benefits are likely to occur as a result of such treatment must be examined. In light of the SDWA criteria, and the status of 1,4-dioxane on the

standard setting agenda of the EPA (it presently is not being considered), we are required to apply the SDWA criteria when evaluating a site-specific standard for this site.

Conclusions

Based on information gathered to date, including bench-scale treatment testing and a treatment system vendor and operator survey, ARCADIS concludes that treatment of 1,4-dioxane to low levels such as the 3 or 6 micrograms per liter (µg/L) proposed by the USEPA and PADEP for the Bally PWS is not feasible, applying the EPA standard for establishing MCLs under the SDWA. Given the byproduct formation, lack of performance history at similar sites, and reliance upon lab to field extrapolation, what likely will constitute BAT for 1,4-dioxane would not be able to achieve the low levels proposed by the regulatory agencies and would most likely result in additional health concerns (the latter as a result of the byproduct formation). In short, the only feasible option that will allow treatment for 1,4-dioxane in the Bally PWS is an appropriately selected cleanup standard that reflects both the generic treatment limitations as well as the site-specific concerns.

If you have any questions regarding this evaluation, please contact us at (267) 685-1800.

Sincerely,

ARCADIS G&M, Inc.

Michael F. Bedard, P.E.
Project Manager

Frank Lenzo, P.E.
Project Director/Associate

Dr. Fred Payne
Project Advisor/Vice President

Attachment

Copies:
Ron Gahagan

Summary of Bench-Scale Testing Analyses
Bally Municipal Well No. 3 Water

Table 1. Concentration of 1,4-Dioxane Versus Irradiance Time for UV/Peroxide Bench-Scale Testing

	1,4-Dioxane Concentration (µg/L)		
Time (min)	Test # 1 (7.3 mg/L Peroxide)	Test # 2 (3.5 mg/L Peroxide)	Test #3 (6.7 mg/L Peroxide)
0	288.8	254.1	295.7
30	260.1	232.9	218.6
30	220.6	225.5	300.7
60	131.3	205.9	162.5
60	125.1	210.8	147.6
90	58.4	161.7	113.3
90	70.1	169.6	103.4
120	32.5	162.3	75
120	26.4	140	63.9

Table 2. Concentration of 1,4-Dioxane Versus Ozonation Time for Ozonation Bench-Scale Testing

	1,4-Dioxane Concentration (µg/L)	
Time (min)	Experiment Set #1	Experiment Set #2
0	60	58
7.5	10	4
15	< 1	< 1
30	< 1	< 1

Table 3. Byproducts Testing Results, UV/Peroxide Bench-Scale Testing (10 mg/L peroxide)

Time (minutes)	1,4-Dioxane (µg/L)	Bromate (µg/L)	Formaldehyde (µg/L)
0	53	NA	NA
7.5	15	< 5	42

NA: Not Analyzed

Table 4. Byproducts Testing Results, Ozonation Bench-Scale Testing

Time (minutes)	1,4-Dioxane (µg/L)	Bromide (µg/L)	Bromate (µg/L)	Formaldehyde (µg/L)
0	58	40	< 5	5
7.5	4	< 10	62	9
15	< 1	< 10	59	13
30	<1	< 10	58	8.4

Note: Water for all testing was collected from a tap after the second air stripping tower but prior to the water chlorination system.

ARCADIS

Infrastructure, buildings, environment, communications

ARCADIS G&M, Inc
6 Terry Drive
Suite 300
Newtown
Pennsylvania 18940
Tel 267 685 1800
Fax 267 685 1801

Mr. Mitch Cron
United States Environmental Protection Agency Region III
Hazardous Site Cleanup Division
1650 Arch Street
Philadelphia, PA 19103-2029

ENVIRONMENTAL

Subject:
Focused Feasibility Study Work Plan, Bally Groundwater Contamination Superfund Site, Bally Borough, Berks County, Pennsylvania
ARCADIS Project No. NP000597

Dear Mr. Cron:

Date:
May 20, 2004

Contact:
Michael Bedard

ARCADIS, on behalf of Sunbeam Products, Inc. (Sunbeam), has prepared the following Focused Feasibility Study (FFS) Work Plan for the Bally Groundwater Contamination Superfund Site. This Work Plan has been prepared in accordance with the requirements presented in the Safe Drinking Water Act (SDWA) Emergency Administrative Order on Consent (AOC) executed by the United States Environmental Protection Agency (USEPA) and Sunbeam on September 30, 2003 which concerns the 1,4-dioxane in the groundwater at the Site.

This Work Plan consists of three sections: Purpose and Scope, Proposed FFS Contents, and Description of Data Analysis and Field Activities. The elements and contents of this Work Plan are consistent with the requirements presented in Subpart E of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR Part 300.430) and USEPA's Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (USEPA, 1988).

Purpose and Scope of FFS Work Plan

This Work Plan describes the proposed data gathering, evaluation and decision-making processes that will be employed during development of the FFS. As required by the SDWA AOC referenced above, the FFS will explore the following options:

- Installation of a new municipal supply well for the Bally Public Water System (PWS); and,
- Treatment of 1,4-dioxane at existing Municipal Well No. 3.

The specific activities that will be addressed in the FFS include the following:

- Identification of Applicable or Relevant and Appropriate Requirements (ARARs), To Be Considered (TBC) standards and guidance, and Remedial Action Objectives (RAOs):
- Identification of potential new water supply well locations;

- Summary and evaluation of recent monitoring data for site-related constituents of concern, including 1,4-dioxane;
- Identification of appropriate treatment technologies and processes for treatment of 1,4-dioxane in Municipal Well No. 3;
- Screening of applicable treatment technologies and processes for treatment of 1,4-dioxane in Municipal Well No. 3 based on effectiveness, implementability, and cost;
- Investigation of potential water supply well locations and analysis of the applicable treatment technologies and processes for treatment of 1,4-dioxane in Municipal Well No. 3, based on the following nine criteria:
    - Overall protection of human health and the environment;
    - Compliance with ARARs;
    - Long-term effectiveness and permanence;
    - Reduction of toxicity, mobility or volume through treatment;
    - Short-term effectiveness;
    - Implementablity;
    - Cost;
    - State acceptance; and,
    - Community acceptance.
- Development of remedial alternatives;
- Comparison of the remedial alternatives: and,
- Recommendation of remedial alternative.

Proposed FFS Contents

The proposed Table of Contents for the FFS is presented below. The final configuration of the FFS may vary from what is presented below, but the general intent and report contents are expected to remain consistent with the information presented below.

Section	Title
1.0	Introduction and Site Characterization
2.0	ARAR, TBC and Remedial Action Objective Identification
3.0	Remedial Technologies, Technology Screening and Development of Remedial Alternatives

4.0 Detailed Analysis of Alternatives
5.0 Recommended Alternative
6.0 References

The data collection activities and decision-making process associated with development of each of the proposed report sections are described in the following section of this Work Plan.

Description of Data Collection and Other FFS Preparation Activities

Data collection, evaluation and other FFS preparation activities are described below, and are organized/numbered by the proposed sections of the FFS.

1.0 Introduction and Site Characterization

This section will describe the purpose and scope of the FFS. Site history, geologic setting, a summary of recent monitoring data and other relevant background information will also be included. The summary of recent monitoring data will include an evaluation of data trends, seasonal impacts and potential variables such as sample collection and analysis methods.

2.0 ARAR, TBC and RAO Identification

ARARs, TBCs and RAOs will be identified in this section. The following categories will be considered during identification of potential ARARs and TBCs:

- Federal requirements – applicable, or potentially relevant and appropriate;
- Pennsylvania state requirements – applicable, or potentially relevant and appropriate;
- Local requirements - applicable, or potentially relevant and appropriate;
- Federal criteria, advisories and guidance documents to be considered (TBCs);
- Pennsylvania state criteria, advisories and guidance documents to be considered (TBCs);
- Local criteria to be considered (TBCs);

Other categories for regional or other entities may be identified during preparation of the FFS.

The AOC referenced above likely will be considered an ARAR for the FFS. The FFS will take into consideration any new risk or health data that becomes available which alters the technical basis for the 1,4-dioxane drinking water standard discussed in the AOC referenced above. The FFS also will consider the feasibility of achieving the 1,4-dioxane treatment concentrations described in the AOC referenced above. The FFS will consider the potential effects of such information on ARARs.

RAOs will be identified during preparation of the FFS. The RAOs will focus on implementation of remedial actions to address 1,4-dioxane that will ensure protection of human health and the environment.

3.0 Remedial Technologies, Technology Screening and Development of Remedial Alternatives

Appropriate technologies will be selected and screened in order to develop a focused list of remedial alternatives.

Remedial Technologies and Technology Screening

Remedial technologies are not applicable for the installation of a new municipal supply well, as this activity is not expected to include treatment of extracted water beyond the chlorination that is typically conducted for water supply systems.

Discussion of remedial technologies for treatment of water from Municipal Well No. 3 will focus on advanced oxidation processes (AOPs) such as gaseous ozonation and ultra-violet light/hydrogen peroxide treatment.

Development of Remedial Alternatives

Two remedial alternatives, based on the remedial options outlined in the SDWA AOC, are likely to be developed. The likely alternatives are as follows:

Alternative 1:

> Installation of New Municipal Supply Well for the Bally PWS, Continued Operation of Existing Municipal Well No. 3 Groundwater Treatment System with Discharge to West Branch Perkiomen Creek (West Branch); and,

Alternative 2:

> Continued Operation of Existing Municipal Well No. 3 Groundwater Treatment System, Additional Treatment of 1,4-Dioxane at Well No. 3, Continued Discharge of Treated Water to Bally PWS and Adjacent Unnamed Tributary.

4.0 Detailed Analysis of Alternatives

The detailed analysis of alternatives will be based upon information collected prior to FFS development, as well as the nine evaluation criteria listed above. Specific factors and information that will be used during the alternatives analysis process are provided below. Permits that are anticipated to be necessary for these alternatives are

identified below; some of these permits will be critical factors in evaluation of the feasibility of the remedial alternatives.

Installation of New Municipal Supply Well

Information on local and regional hydrogeology and land use will be used to evaluate potential new supply well locations. This information will include the following:

- Area- and site-wide geology and hydrology;
- Water use/quality information;
- Fracture trace analyses;
- Proximity to groundwater contamination sites such as the Bally Site and the Crossley Farms Superfund Site; and,
- Land use and zoning.

More detailed information on the technical approach for location of a new municipal supply well is presented in Attachment 1 to this Work Plan.

Information obtained from activities conducted as of the time of FFS preparation will be included in the FFS. These activities likely will include:

- Test borehole drilling;
- Test well installation;
- Aquifer pumping test(s);
- Water quality analyses;
- Evaluation of criteria such as water quality (risk-based allowable consumption concentration for 1,4-dioxane, PADEP New Source Sampling Requirements and PADEP Maximum Contaminant Levels (MCLs) for Primary and Secondary Contaminants) and potential well yield;
- Evaluation of continued pumping and treatment at Municipal Well No. 3, and the potential for future increases in the horizontal or vertical extents of the existing groundwater plume;
- Evaluation of the potential impact of future potable and non-potable water supply wells in the vicinity of a new municipal supply well, and the potential roles of regulatory entities such as Washington Township and the Delaware River Basin Commission (DRBC);
- Evaluation of mechanical system and piping design issues;
- State and regional regulatory permitting;
- Engineering and administrative considerations regarding Bally water distribution system; and,
- Access agreement negotiation.

The information obtained through execution of these activities will be critical to the analysis of the feasibility of installing a new municipal supply well in the vicinity of Bally Borough.

Continued Operation of Existing Groundwater Treatment System with Discharge to West Branch

If the new supply well alternative is selected and successfully executed, the existing groundwater treatment system would likely continue to operate, and the treated water would be discharged to a new outfall location at the West Branch. Potential discharge pipeline alignments, and their physical and administrative constraints, will be described in the FFS.

Some of the infrastructure, permits and approvals anticipated for a new pipeline and outfall are as follows:

- Pipeline, discharge pump, controls and outfall structure;
- Pennsylvania Department of Environmental Protection (PADEP) approval of a National Pollutant Discharge Elimination System (NPDES) permit for the treatment system effluent;
- PADEP Wetlands and Water Encroachment permits;
- Approval of a Soil Erosion and Sediment Control Plan from the Berks County Conservation District;
- Access agreement negotiation; and,
- Approval from Bally Borough, Washington Township and/or the Pennsylvania Department of Transportation for construction of the pipeline within public road rights-of-way and other public property.

Consideration of whether a limited evaluation of the potential ecological impacts (or lack thereof) of groundwater discharge to the West Branch is appropriate. The range of 1,4-dioxane concentrations typically observed in the effluent of the existing treatment system (typically <0.045 mg/L) is well below the level of concern for ecological receptors. Detailed background information on the limited potential for ecological impacts will be included in the FFS.

Continued Operation of Existing Municipal Well No. 3 Groundwater Treatment System with Additional Treatment for 1,4-Dioxane

Bench-scale testing for AOPs such as gaseous ozonation and ultra-violet light/hydrogen peroxide treatment has been conducted on samples of water from Bally Municipal Well No. 3. The results of this testing, as well as a vendor/operator survey, were described in the August 20, 2003 ARCADIS letter to USEPA. The FFS will include the information obtained during preparation of this evaluation, conclusions from the evaluation letter, and any other relevant information obtained since preparation of the letter.

Anticipated infrastructure and permitting considerations include the following:

- Construction of additional treatment infrastructure such as electrical system upgrades, mechanical system modifications, equipment building additions, and site upgrades;
- Modification and/or renewal of the existing NPDES, Water Supply and air quality permits through PADEP due to changes in the treatment system; and,
- Building permits required from the Borough of Bally.

Other considerations in the FFS evaluation will include:

- Treatment process by-products and the associated regulatory requirements and potential control options;
- Technology limitations and potential process control issues;
- Limitations of treatment technologies to consistently achieve treatment objectives; and
- Ability of technologies to reach regulatory standards and/or goals.

Continued Discharge of Treated Water to Bally PWS and Adjacent Unnamed Tributary

If groundwater is treated for 1,4-dioxane, excess water that is not discharged to the Bally PWS likely will be discharged to the unnamed tributary next to Municipal Well No. 3 in the same manner as such discharges presently occur. Continued discharge of treated water to the unnamed tributary would require modification of the existing NPDES permit for the treatment system through PADEP. Existing infrastructure associated with the existing outfall location would continue to be used.

5.0 Recommended Alternative

The basis for recommendation of one alternative will be made in this section.

6.0 References

Documents referenced in the FFS will be listed in this section.

Attachment 2 to this Work Plan includes comments received from USEPA on the draft FFS Work Plan (February 26, 2004), Sunbeam/ARCADIS responses to those comments (March 12, 2004), and additional comments received from USEPA on April 21, 2004. Attachment 3 presents a schedule for field activities and deliverables associated with preparation and finalization of the FFS.

ARCADIS

We trust that this Work Plan adequately describes the proposed activities for preparation of the FFS. If you have any questions or comments regarding this Work Plan, please contact Michael Bedard at (267) 685-1821.

Sincerely,

ARCADIS G&M, Inc.

Michael F. Bedard, P.E.
Project Manager

Frank Lenzo, P.E.
Project Director/Vice President

Attachments

Copies:
Roger Reinhart, USEPA
Asuquo Effiong, PADEP
Susan Werner, PADEP
Toni Hemerka, Bally Borough
Ron Gahagan, American Household, Inc.